ZOOGEOGRAPHY OF NORTH AMERICAN UNIONACEA (MOLLUSCA: BIVALVIA) NORTH OF THE MAXIMUM PLEISTOCENE GLACIATION

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ABSTRACT. The Unionacea (Mollusca: Bivalvia) now found north of the maximum Pleistocene glaciation in North America (which extended roughly to the Missouri and Ohio rivers in the west and to the New York–Pennsylvania boundary in the east), excluding two species of western origin, migrated there from southern refugia and are not autochthonous. The probable origins and likely migration routes of the unionids found in that northern region are discussed with special emphasis on their movements within the American Interior Basin.

In addition to a ubiquitous fauna widely dispersed in both the Mississippi and Ohio rivers, and found on both the Ozark and Cumberland plateaus, each plateau has a unique assemblage of species. The post-glacial migration of some of these Ozarkian, Cumberlandian, and Ohioan species accounts for the differences in the faunas of the Mississippi River above the Missouri River (Mississippian Region) and the Ohio River drainage (Ohioan Region). Tables list the faunas of the several river systems and the species are listed to indicate their probable refugia. Fourteen species are monographed and in-

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clude their known distributional records. Eight of these are found only in the Ozarkian Region. Among the additional six species, two other Ozarkian species are included which extended their ranges in post-glacial time, *Lampsilis higginsi* and *Proptera capax*. *Lampsilis higginsi* and *abrupta*, a closely related Cumberlandian species, are compared. They illustrate overlapping distribution in the Mississippian and Ohioan regions. *Cyprogenia stegaria*, a Cumberlandian species which extended its range into the Ohioan Region, is compared with *C. aberti*, an Ozarkian species. *Arcidens confragosus* and *Anodonta suborbiculata*, which extend south to the Gulf Coastal Region, are examples of species that entered the Ohioan Region from the West. The repopulation of the St. Lawrence River system by species from the Ozarkian, Mississippian, Cumberlandian, Ohioan, and Northern Atlantic Slope regions is discussed as is the repopulation of the Canadian Interior Basin.

INTRODUCTION

This paper brings together the available data on the distribution of the Unionacea found north of the maximum Pleistocene glaciation in North America (roughly to the Missouri and Ohio rivers in the west and to the New York–Pennsylvania boundary in the east). Much of this vast area was repopulated within approximately the past ten thousand years during the retreat of the Wisconsin ice sheet. Many of the dispersal routes have been documented, but no previous paper discusses the probable refugia of the species, or lists the known faunas of the relevant river systems.

It should be mentioned that the mobility, and thus the means of dispersal, of the Unionacea is passive. It is dependent on the temporary attachment of the larval forms (glochidia) onto passing fish.

ZOOGEOGRAPHY OF NORTH AMERICAN UNIONACEA NORTH OF THE MAXIMUM PLEISTOCENE GLACIATION

Introduction. Prior to the Cretaceous Period the then Cumberland Plateau extended continuously from the Appalachian Mountains southwest into western Texas. The Mississippi River did not exist. What is remarkable about the present unionid faunas on the Ozark Plateau, on both sides of the Ozark Crest, and on the Cumberland Plateau, is their similarity, even after the passage of some 200 million years. The maximum Pleistocene glaciation extended southward, west of the Appalachian Mountains, roughly to the present Missouri and Ohio rivers, and to the Pennsylvania–New York boundary in the east. During the Nebraskan glacial stage, which represents the earliest and most southerly extension of the ice sheet, the unionid fauna was eliminated north of this line. With the exception of two species from the Pacific Coastal Region, the Interior Basin (including the Canadian Interior Basin), the St. Lawrence River system, and the Northern Atlantic Slope, have since been repopulated with species from southern refugia.

Ozarkian Region. The upper portions of the Red River system, Oklahoma and Arkansas; Black River system, Arkansas; Arkansas River system, Kansas, Oklahoma, and Arkansas; White River system, Missouri and Arkansas; St. Francis River system, Missouri and Arkansas, all below the Ozark Crest; and the Osage, Gasconade, and Meramec river systems, all in Missouri, and all above the Ozark Crest; contain an assemblage of 8 species of Unionidae found nowhere else (Tables 1, 5 E). These river systems comprise the Ozarkian Region (H. and A. van der Schalie, 1950: 450, map 1 IV).

In addition to these 8 species (Table 5 E) there are two others, *Lampsilis higginsi* and *Proptera capax*, which have spread beyond into the Mississippian and Ohioan regions, the latter also into the Lake Erie drainage of the St. Lawrence River system. Four species (Table 5 D) occur in the Ozarkian and Cumberlandian regions which are not found in the Mississippian Region. Nine species (Table 5 C) found in the Ozarkian are not found in the Mississippian or in the Cumberlandian regions but are found in the Gulf Coastal Region. Nine species (Table 5 B) found in the Gulf Coastal and Ozark-

ian regions are also found in the Mississippian and Ohioan regions. With the exception of *Lampsilis radiata siliquoidea* in the Cumberlandian Region, 40 species (Table 5 A) occur in the Meramec River system, which are generally distributed in both the Mississippian and Ohioan regions.

Cumberlandian Region. Ortmann (1924a: 40) defined the Cumberlandian Region to include: the drainages of the Tennessee River system from the headwaters to the vicinity of Muscle Shoals, in Colbert and Lauderdale counties, Alabama; and the Cumberland River system from the headwaters to the vicinity of Clarksville, Montgomery County, Tennessee (Ortmann, 1925: 366). Ortmann (1924a: 40) discussed the unionid fauna of the Duck River drainage, which is at present, a tributary of the Tennessee River system. The upper portion of the Duck River has a fauna that is 38 percent Cumberlandian. Ortmann suggested that this was the original fauna and that there once had been stream confluence with it and both the Tennessee and Cumberland river systems.

Originally Ortmann (1924a: 40) regarded as Cumberlandian only those unionid species currently confined to the areas of the Tennessee and Cumberland river systems as defined above. This Cumberlandian fauna consists of 30 species (Table 1). All but one of these occur in the Tennessee River, and 21 are also found in the Cumberland River. Later Ortmann (1925: 370) suggested that there were Cumberlandian species that had descended the Tennessee and/or Cumberland rivers and invaded the Ohio drainage, though he never indicated which they were. Table 2, C indicates that the following are those additional Cumberlandian species:

52 *Lampsilis abrupta*
40 *Carunculina glans*
20 *Plethobasus cicatricosus*
46 *Plagiola personata*
47 *Plagiola flexuosa*
43 *Plagiola sampsoni*
44 *Plagiola propinqua*

See appropriate number under: Unionacea of the Mississippian and Ohioan Regions With Refugia in Tributaries of the Missouri and Ohio rivers on Their South Side [List 1].

Thirty-seven of the 90 species of unionids found in the Tennessee River are Cumberlandian, as are 27 of the 78 found in the Cumberland River. These two assemblages are the largest number of unionid species found in any of the world's rivers.

Mississippian Region. H. and A. van der Schalie (1950, map 1) regarded as the Interior Basin (or Mississippian Region), all of the river in the Gulf Coastal Region, from the Rio Grande to and including the Mobile-Alabama-Coosa River; the entire Mississippi River system, including the Ohio; the Canadian Interior Basin; and the St. Lawrence River system west of Lake Erie. Excepted were the Ozarkian and Cumberlandian regions as defined above.

The Mississippian Region is more narrowly defined here to include: the Missouri River and all those rivers draining into its south side, excluding the Osage, Gasconade, and Meramec river systems which are in the Ozarkian Region; the Blackwater River since it has no Ozarkian species in it; and all of the Mississippi River, above the Missouri, and the rivers flowing into it west and north of the Ohio River. In this area, as thus defined, occur 53 species of Unionacea; 40 are so uniformly distributed, in both the Mississippian and Ohioan regions, that little can be said of their general zoogeography. All of them occur in the Meramec River system, which may have been the major refugium for these species west of the Ohio River (Table 2 A). With the exception of *Margaritifera falcata*, from the Pacific coastal Region, 11 other species had refugia below the Ozark Crest, and five also had a refugium in the Meramec River.

These 11 western species penetrated the Ohioan Region to some extent, yet only one Ohioan and one Cumberlandian species occur in the Mississippian Region. During the Wisconsin glacial stage (Plate 1), the ice sheet in the Mississippian Region was much less extensive than in the Ohioan Region, and perhaps, the former fauna had achieved a stability that prevented the newly available Ohioan fauna from penetrating it.

Ohioan Region. This area consists of all the rivers that flow into the Ohio River, excluding the Tennessee and Cumberland rivers.

There are 72 species of Unionacea in this area, 40 of which are found in the Mississippian Region as well (Table 2, A). The Green, Salt, and Kentucky rivers, on the south side of the Ohio, are each fairly well represented by this group of species; but the Tradewater, Licking, and Big Sandy rivers are not, suggesting that these were repopulated in post-glacial time. In addition to the seven species found in the Ohio River drainage, regarded above as Cumberlandian, are 16 additional species that appear to be of Ohioan origin (Table 2, C). With the exception of *Lasmigona compressa*, missing in the Tennessee, Cumberland, and Green rivers, all the other species occur in the Tennessee River, and most are also found in the Cumberland and Green rivers.

Ortmann (1926: 186) concluded that "there is a sharp line between the Cumberland and Green rivers in southern Kentucky separating two apparently old faunas, the Cumberlandian and Ohioan." Ortmann (1913: 382) had previously indicated that the Kentucky, Licking and Big Sandy rivers contained Ohioan species (Table 2, C) and suggested that the uniformity of the fauna of the upper Ohio basin was a character acquired in post-glacial time. He further noted that remnants of the pre-glacial Ohioan fauna may have had refugia in the Kanawha, Monongahela, and [Allegheny] rivers.

Table 2, C indicates that the Tennessee and Cumberland rivers were major refugia of both Cumberlandian and Ohioan unionid species, and the Green River was a major refugium for the Ohioan species. These rivers appear to be the most important refugia for those species that repopulated the Wabash and Greater Maumee rivers (Plate 1, D).

Table 2, B shows the distribution of 11 Mississippian unionids that penetrated the Ohioan Region. Most of these species penetrated at least to the Wabash River drainage.

St. Lawrence River System. The St. Lawrence River system has no natural connections with the Mississippi or Ohio river systems, and flows for some 2,000 miles east to the Atlantic Ocean. Walker (1913: 18) studied the distribution of the unionids found in the Great Lakes.

Lake Superior. Walker found *Elliptio complanata*, an Atlantic Slope species, in Lake Superior, at the western extremity of the St. Lawrence River system. He suggested that this species arrived in this area by way of the Mohawk and Trent outlets into Georgian Bay of Lake Huron and from there into Lake Superior (Walker, 1913: 58). Ortmann (1924b) confirmed this, pointing out that toward the end of glacial time, Lakes Superior, Michigan, and Huron (then Lake Algonquin IV) flowed through the Trent Valley from Georgian Bay, Lake Huron, directly into Lake Ontario (then Lake Iroquois). Later the North Bay outlet opened, allowing the water to flow from the end of Georgian Bay through the Ottawa Valley to the Ottawa Sea. After the weight of glacial ice was removed by further melting, the Ottawa Valley was sufficiently elevated to eliminate it as an outlet.

Clarke (1973: 40) pointed out that *E. complanata* has a continuous distribution in the Hudson Bay drainage from the Moose River system in northwestern Quebec and northeastern Ontario to the headwaters of the Albany River system in northwestern Ontario. Since the head-

waters of the Albany River are *still* connected to Lake Superior through Long Lake and Lake Nipigon, there can be little doubt that this route also served in the post-glacial migration of *E. complanata* into Lake Superior.

Lake Michigan. Van der Schalie (1963) established that a number of unionid species found in the Millecoquin River, in the eastern part of the Upper Peninsula of Michigan, the Carp and Ocqueoc rivers, in the northern part of the Lower Peninsula, presently draining into Lakes Michigan and Huron; indicate that these rivers were once connected to the now submerged Mackinac River system. This system received its fauna from the Fox River which was then connected to the Wisconsin River in the vicinity of Portage, Columbia Co., Wisconsin (Plate 1, B). He further established that the present distribution of the unionids in the rivers of western Michigan indicate that before the formation of Lake Michigan, the rivers of western Michigan (e.g. the Muskegon, Grand, and St. Joseph) connected with the Des Plaines River through the Chicago Outlet and Illinois River to the Mississippi (Plate 1, C). He also deduced that the Muskegon River was at one time a tributary of the Grand River (of western Michigan) and also that the fauna of the Saginaw, now flowing into Lake Huron, was derived from the previously mentioned Grand River during the confluence of the former drainages (van der Schalie, 1961: 157).

Lake Erie. Ortmann (1924b) pointed out that during the Trent Stage of the Wisconsin, the Maumee River flowed through the partially dry bed of Lake Erie into the Wabash River. The Maumee and Wabash rivers were connected in the vicinity of Fort Wayne, Allen Co., Indiana (Plate 1, D). It was by this route that 43 species of unionids (Table 3, A), from the Mississippian, Cumberlandian, and Ohioan faunas, found their way into the Greater Maumee drainage. Many of these species are not found in Lake Erie proper. On the basis of the unionid faunas of rivers now flowing into Lake Erie, Ortmann concluded that the Huron and Raisin rivers in Eastern Michigan; the Sandusky, Vermilion, Lower Cuyahoga and Grand rivers in Ohio; as well as the Grand River in Ontario were once part of the Greater Maumee drainage. Van der Schalie (1938), also on the basis of unionid distribution, concluded that the Clinton River, which flows into Lake St. Clair, was also part of the Greater Maumee drainage; but he determined that the Rouge River, between the Clinton and Huron rivers, was of later origin (Figure 1).

Lake Ontario. This, the newest of the Great Lakes, has a unionid fauna of seven species. Two are Atlantic Slope species. Clarke and Berg (1959: 3) monographed the species found in this lake and those of the Genesee River and Finger Lakes Basin which flow into it on its south side, and suggested that the Atlantic Slope species found there were derived from the Susquehanna Basin by way of glacial Lake Newberry. When the Wisconsin ice sheet melted, the Finger Lakes Basin was inundated by Lake Newberry which, in its earlier stages, drained southward into the Susquehanna drainage basin (Plate 1, E). As the glacier continued to recede a lower channel was uncovered and the water drained westward into the Erie Basin. Later, when an even lower outlet was uncovered, the lake in the Erie Basin merged with the Finger Lakes Basin and flowed eastward into the Mohawk and Hudson river valleys (Plate 1, F).

Lake Champlain. Simpson (1896: 381) suggested that sometime since the end of the Wisconsin, there had been a connection between the Hudson River and Lake Champlain when the Erie Basin merged with the Finger Lakes Basin and flowed eastward into the Mohawk and Hudson river valleys. He further suggested that the Lake Champlain fauna may have been derived from the St. Lawrence Riv-



Figure 1. Trent outlet stage of the Great Lakes. (After Ortmann, 1924, fig. 2.)

The darkened area represents the melt water which flowed through the Trent Outlet into the Mohawk River (arrow). The Greater Maumee River system is postulated, and the rivers which formed part of it are numbered. 1. Clinton, 2. Huron, 3. Raisin, 4. Sandusky, 5. Vermilion, 6. lower Cuyahoga, 7. Grand River, Ohio, 8. Grand River, Ontario. The arrow between 3 and 4 represents the flow of the Maumee River system into the Wabash.

er by way of the Richelieu River. Since the present fauna, with the exception of *Elliptio complanata*, is from the west, this second explanation is more probable.

Ottawa River. It is assumed that the large number of Atlantic slope species in the Ottawa River are derived from the southern side of the lower St. Lawrence River, but this is not documented here.

Canadian Interior Basin. (Plate 1, Insert.) North of the Mississippian Region and the St. Lawrence River system, this vast region comprises more than one third of North America. It is divided into the Arctic and Hudson Bay drainages. The latter has a number of natural connections with the St. Lawrence River system. The Albany River system in Ontario is joined to Lake Superior by Lake Nipigon and Long Lake, both of which have north and south flowing outlets. The Rainy River–Winnipeg River system is similarly joined to Lake Superior at Saganaga [Seiganagah] Lake which drains both east and west (Clarke, 1973: 6). Most of the unionid fauna of the Canadian Interior Basin is of Mississippian origin (Table 4). Thirteen of the 16 species in the Hudson Bay drainage are derived from a former confluence of the Minnesota River, of the upper Mississippi, and the Red River of the North (Plate 1, A). Prior to the recent erection of dams, these rivers were periodically joined by floods (Dawley, 1947: 680). Three of these 13

species were also derived from the St. Lawrence River system, and an additional species was described exclusively from the latter system. One species is from the Pacific Coastal region and one appears to be speciating in the area. Only three of the 16 species occur in the Arctic Region.

Pacific Coastal Region. This consists of rivers that flow into the Pacific Ocean to, and including, Alaska which was unglaciated. The unionid fauna is comprised of eight species, two of which are found outside of the region.

Northern Atlantic Slope Region. The unionid fauna of the Northern Atlantic Slope consists of 15 species, all of which had refugia south of the Terminal Moraine. This also includes one subspecies, *Anodonta cataracta fragilis* found in Newfoundland, New Brunswick and Nova Scotia.

FAUNAL STUDIES

The tables in this paper are based mostly on reliable published records, and on specimens in the Museum of Comparative Zoology, or elsewhere, as noted.

Ozarkian Region. The unionid fauna of the Red River system was enumerated by Isely (1925), Strecker (1931), and by Valentine and Stansbery (1971). The unionids of the Ouachita River drainage of the Black River system were listed by Wheeler (1918). The unionids of the upper tributaries of the Arkansas River system in Kansas were studied by Scammon (1906), Clarke and Gillette (1911), and again by Murray and Leonard (1962). The unionids of the tributaries of the Neosho River drainage in Missouri were listed by Utterback (1917), and those of the Arkansas River system in Oklahoma by Isely (1925). The unionids of the White and Black river drainages of the White River system in Missouri were monographed by Utterback (1915–1916), and those of the White River in Arkansas were studied by Call (1885). Meek and Clark (1912) listed the unionids of the Big Buffalo Fork, and Wheeler (1914) those of the Cache River, both tributaries of the White River in Arkansas. Utterback (1917) listed the unionids of the St. Francis River system in Missouri, and Call (1885) studied those in Arkansas. The unionid faunas of the Osage, Gasconade, and Meramec rivers were summarized by Utterback (1917) in a table. A recent report by Buchanan (1977) based on extensive collections from the Meramec River was very useful in establishing its fauna. Buchanan (1980) later added *Anodontoides ferussacianus* and *Simpsoniconcha ambigua* to the Meramec River fauna. Gordon, *et al.* (1980), while primarily interested in the unionids of Arkansas as a political unit, added a number of records to several of the Ozarkian river systems. The faunas of the Osage and Gasconade rivers, as well as some of the drainages south of the Ozark Crest, were augmented by records made by the 1964 Harvard-Ohio State Museum expedition to this area.

Mississippian Region. The unionids of the upper Missouri River were studied by Coker and Southall (1915). West of the Osage River, and like it flowing into the Missouri River on its South side, is the Blackwater River. Since, according to Utterback's (1917) table its fauna includes no Ozarkian species, it properly belongs in the Mississippian Region. The distribution and number of unionid species in the Mississippi River, discussed by H. and A. van der Schalie (1915), was based on several mussel surveys made in the Mississippi River, including one by Grier and Mueller (1922–23), and on the extensive collection made by Max. Ellis during 1930–31.

Baker's (1928) monograph of the Wisconsin mollusks was useful in establishing the fauna of the Wisconsin and Fox rivers, as was Dawley's (1947) report which enumerated the fauna of the Minnesota River and mentioned its relation-

ship to the Red River of the North. The present (1973–77) distribution of the unionids of the upper Mississippi River in Wisconsin was made available by Mathiak (1979). The fauna of the Illinois River, past and present, was studied by Starrett (1971). The unionids of its tributaries in the Kanakee Basin had been enumerated by Wilson and Clark (1912). A popular work by Parmalee (1967) on the freshwater mussels of Illinois also contained useful records.

Cumberlandian Region. Ortmann (1918) reported on the unionid fauna of the upper Tennessee River. Subsequently, additional collections have been reported upon from its upper most tributaries. The species in the Powell River were listed by Ahlstedt and Brown (1980), those of the Clinch River by Stansbery (1973) and again by Bates and Dennis (1978). Ortmann (1925) reported on the lower Tennessee River, below Walden Gorge, to Muscle Shoals in Lauderdale and Colbert counties, Alabama, to which van der Schalie (1939) added additional notes. Ortmann (1924a) studied the unionids of Duck River, a tributary of the lower Tennessee. The Duck River unionids were restudied by Isom and Yokley (1968) and subsequently reexamined by van der Schalie (1973). The unionid fauna of the Cumberland River was studied by Wilson and Clark (1914), and that of the upper part of the river, above the Tennessee boundary, was examined again between 1947–1949 by Neel and Allen (1964) before the completion of the Wolf Creek Dam. Blankenship and Crockett (1972) listed the unionids found in the Rockcastle River from Livingston, Kentucky.

Ohioan Region. The first important summary of the Ohioan unionid fauna was made by Call (1897) in a paper on the molluscan fauna of the hydrographic basins of Indiana, in which he listed those species found in the Wabash River and its tributaries. Call's (1900) monograph of Indiana mollusks was supplemented by both Blatchley and Daniels (1903) and Daniels (1915) and was revised by Goodrich and van der Schalie (1944). Baker (1922) studied the molluscan fauna of the Big Vermilion River, a large tributary of the Wabash in Illinois. Meyer (1974) investigated the fauna of the Wabash and White rivers in Indiana, and Clark (1976) reviewed the unionid fauna, past and present, of the Wabash River drainage. The unionids of the Green River were extensively studied by Ortmann (1926) and were listed again by Clench and van der Schalie (1944). Stansbery (1965) added several formerly unreported species from the vicinity of Munfordville, Kentucky. The Kanawha (or New) River unionids were listed by Ortmann (1913: 305–308) and again by Morris and Taylor (1978). The fauna of the Monongahela, Allegheny, and upper Ohio rivers were discussed in Ortmann's (1919) elegant monograph of Pennsylvania naiades.

The unionids of the Tradewater and Salt rivers were listed by Clench and van der Schalie (1944), and Rosewater (1959) again listed the species of the Salt. Those of Floyd's Creek, a tributary of the Salt River, were listed by Taylor (1980b). The unionids of the Kentucky River were studied by Danglade (1922). Ortmann (1913: 308–310) listed those of the Licking and Big Sandy rivers.

In addition to the Wabash River, from west to east, there are three other major tributaries on the north side of the Ohio River: the Miami, Scioto and Muskingum. The Miami River is not included in Table 2 because there is no published list of its unionids. It is reasonable to assume that the fauna of the Miami River is, or was, similar to that of the Scioto and Muskingum rivers. A mimeographed list of the Scioto River species was circulated by Stansbery (1961). The species of Little Darby Creek, one of its tributaries, were listed by Stein (1965). Most of the species of the Muskingum drainage are covered by Sterki (1900, 1902) in papers on the

land and freshwater mollusca of the upper Tuscarawas Valley.

La Rocque's (1967) compilation on the unionids of Ohio contained useful information on the distribution of Ohio species. Ortmann's (1909, 1912, 1919) studies of the naiades of Pennsylvania record the unionid fauna of the upper Ohio drainage.

A number of mimeographed reports by state and federal agencies on the present reduced naiad fauna of the Ohioan region have appeared, and should be mentioned, although they did not include data required here. Williams (1969) reported on the mussel fisheries in the Tennessee, Ohio and Green rivers, Bates (1970) on the Ohio mussel fisheries, Dennis (1970) on the mussels of Pennsylvania, and Bates (1971) and Taylor (1980a) on the mussels of the West Virginia portion of the Ohio River.

St. Lawrence River System.

Lake Superior. The Lake Superior unionids were listed by Goodrich and van der Schalie (1932).

Lake Michigan. The unionids of Lake Michigan, and the tributaries on its western side in Wisconsin, were studied by Baker (1928). The Wisconsin tributaries were extensively collected during 1973–77 and reported on by Mathiak (1979), who added five new records. Van der Schalie (1961) enumerated the fauna of the Fox River in Wisconsin that flows into western Lake Michigan, and listed the species from a number of western Michigan rivers that flow into Lake Michigan on its eastern shore. Van der Schalie (1936, 1941, 1963) also listed the unionids of the St. Joseph, Grand and Muskegon rivers, on the lower Michigan Peninsula. The unionids of Lake Michigan proper were listed by Goodrich and van der Schalie (1932).

Lakes Huron and St. Clair. The unionids of these lakes were listed by Goodrich and van der Schalie (1932).

Lake Erie. The Lake Erie unionids were listed by Walker (1913), Ortmann (1924b), and by Goodrich and van der Schalie (1932). Stansbery and Stein (1962) circulated a useful mimeographed list of the unionids of the Island Region in the western part of Lake Erie. Robertson and Blakeslee (1948) listed the unionids found in the easternmost part of the Lake and of the rivers which flow into it in the Niagara Frontier Region. The naiades of the Huron River in southern Michigan, that flows into western Lake Erie, were studied by van der Schalie (1938). The fauna of the Maumee River, which also flows into western Lake Erie, were enumerated by Call (1897), and again by Wilson and Clark (1912) based on new collections. Clark (1977) listed the unionids of the St. Joseph River, a tributary of the Maumee. Strayer (1979) again listed the naiads of the St. Joseph River, as well as those of the Raisin and Huron rivers.

Lake Ontario. The Lake Ontario unionids were listed by Goodrich and van der Schalie (1932). Clarke and Berg (1959) monographed the unionids of Lake Ontario and those species found in the Finger Lakes Region, draining into the Lake on its south side.

Lake Champlain. The Lake Champlain unionids were listed by C. W. Johnson (1914).

Ottawa River. The unionids of Ottawa River, a major tributary of the St. Lawrence River, are based on the lists of Latchford (1882) and Whiteaves (1895), and especially on La Rocque and Oughton's (1937) account of the Unionidae of Ontario.

Canadian Interior Basin. The unionid fauna of the Arctic and Hudson Bay drainages is based on the summary by Clarke (1969) and on the distributional maps in Clarke's (1973) monograph of the Canadian Interior Basin mollusks.

Pacific Coastal Region. The list of Unionacea from the Pacific Coastal Region is from Burch (1973, 1975).

Northern Atlantic Slope Region. The

list of Unionacea from the Northern Atlantic Slope is from Johnson (1970). Papers by Athearn and Clarke (1962) and Clarke and Rick (1963) were also used.

NOMENCLATURE

The nomenclature and arrangement of the species covered in this paper are essentially those of Burch (1973, 1975). Exceptions are mentioned in the notes and under the several monographed species. The species concepts and arrangement of *Plagiola* are those of Johnson (1978), as are the Atlantic Slope species (1970). The unionid species from the Canadian Interior Basin are from Clarke (1973).

Simpson, and some later authors, especially F. C. Baker, gave nomenclatorial standing to a number of ecophenotypic variants; while the names applied to these have no standing as species or subspecies in modern systematics, some still continue to appear in the literature.

Included as notes under the species in the several faunal lists are names which have been promulgated in the literature since Simpson's (1914) monographic work on the Unionacea. Not listed are the taxa introduced by the Sicilian nobleman, Marchese A. De Gregorio (1914), who redescribed many well known North American unionids with abandon. All of his taxa were synonymized by Walker (1918) and have since been forgotten.

Morrison (1969) asserted that a number of Rafinesque's taxa, previously thought unrecognizable, had priority over a number of well known ones. Since he gave no support for his assertions, Rafinesque's names are placed under their supposed synonyms.

DISTRIBUTION OF UNIONIDAE FROM THE RIVERS SOUTH OF THE MAXIMUM PLEISTOCENE GLACIATION, WHICH FLOW INTO THE MISSOURI AND OHIO RIVERS, THAT HAVE NOT EXTENDED THEIR RANGE [Table 1]

UNIONACEA OF THE MISSISSIPPIAN AND OHIOAN REGIONS WITH REFUGIA IN TRIBUTARIES OF THE MISSOURI AND OHIO RIVERS ON THEIR SOUTH SIDE [List 1]

In addition to the 72 species listed below, the fauna also includes two species from elsewhere: a. *Margaritifera falcata* from the North Pacific Coastal Region found in the Mississippian Region, and B. *Elliptio complanata* from the North Atlantic Slope Region found in the Ohioan Region.

FAMILY MARGARITIFERIDAE

1. *Cumberlandia monodonta* (Say 1829)
 Found below the Ozark Crest only in the:
 BLACK RIVER SYSTEM

 Ouachita River Drainage. *Arkansas:* Ouachita River, above Skillern's Shoals, Arkadelphia, Clark Co. (Wheeler, 1918: 121).

FAMILY UNIONIDAE

2. *Amblema plicata* (Say 1817)
 Unio peruviana Lamarck 1819; *Amblema costata* Rafinesque 1820; *Unio undulatus* Barnes 1823; *Unio rariplicata* Deshayes 1830; *Unio perplicata* Conrad 1841; *Quadrula perplicata quintardii* Cragin 1887; *Unio pilsbryi* Marsh 1891, Nautilus **5:** 1 (Little Red River, Arkansas; holotype ANSP 41589a figured by Pilsbry, 1892, Proc. Acad. Nat. Sci. Phila. **44:** 131, pl. 8, figs. 7–8; also 1892, Nautilus **6:** 1, pl. 1, figs. 7–8); *Cokeria southalli* Marshall 1916.

3. *Fusconaia ebena* (Lea 1831)
 Obliquaria pusilla Rafinesque 1820 (Morrison, 1969: 24).

4. *Fusconaia flava* (Rafinesque 1820)
 Unio rubiginosus Lea 1829; *Unio cerinus* Conrad 1838; *Unio hebetatus* Conrad 1834; *Unio rubidus* Lea 1861; *Fusconaia flava parvula* Grier 1918.

TABLE 1

DISTRIBUTION OF UNIONIDAE OF THE RIVERS SOUTH OF MAXIMUM PLEISTOCENE GLACIATION THAT FLOW INTO THE MISSOURI AND OHIO RIVERS, THAT HAVE NOT EXTENDED THEIR RANGE

	OZARKIAN REGION				CUMBERLANDIAN REGION					
	below Ozark Crest	Osage River System	Gasconade River System	Meramec River System	Tennessee River System	Duck River Drainage	Cumberland River System	Green River System	Kanawha (or New) River System	NOTES
Lampsilis brevicula (Call 1887)	X	X	X	X						(1)
Ptychobranchus occidentalis (Conrad 1836)	X			X						(1)
Cyprogenia aberti (Conrad 1850)	X			X						(1)
Fusconaia ozarkensis (Call 1887)	X		X							(1)
Fusconaia barnesiana (Lea 1838)					X	X	X			(2)
Quadrula tuberosa (Lea 1840)					X	X	X			(3)
Pleurobema oviforme (Conrad 1834)					X	X	X			(4)
Alasmidonta raveneliana (Lea 1834)					X		X			(5)
Pegias fabula (Lea 1836)					X		X			
Actinonaias pectorosa (Conrad 1834)					X	X	X			(6)
Plagiola interrupta (Rafinesque 1820)					X		X			
Plagiola arcaeformis (Lea 1831)					X		X			
Plagiola lenior (Lea 1842)					X	X	X			
Plagiola biemarginata (Lea 1857)					X		X			
Plagiola capsaeformis (Lea 1834)					X	X	X			
Plagiola florentina (Lea 1857)	X				X	X	X			
Plagiola turgidula (Lea 1858)	X				X	X	X			
Plagiola haysiana (Lea 1834)					X		X			
Plagiola stewardsoni (Lea 1852)					X		X			
Medionidus conradicus (Lea 1834)					X	X	X			(7)
Villosa taeniata (Conrad 1834)					X	X	X			(8)
Villosa trabalis (Conrad 1834)					X		X			(9)
Villosa vanuxemensis (Lea 1838)					X	X	X			
Dromus dromas (Lea 1834)					X		X			(10)
Ptychobranchus subtentum (Say 1825)					X	X	X			
Fusconaia cuneolus (Lea 1840)					X					(11)
Fusconaia edgariana (Lea 1840)					X					(12)
Quadrula intermedia (Conrad 1836)					X					
Lexingtonia dolabelloides (Lea 1840)					X	X				(13)
Lasmigonia holstonia (Lea 1838)					X	X				(14)
Lampsilis virescens (Lea 1858)					X					(15)
Lemiox rimosus (Rafinesque 1831)					X	X				
Carunculina cylindrella (Lea 1868)					X					(16)
Pleurobema gibberum (Lea 1838)							X			(17)
Villosa ortmanni (Walker 1925)								X		(18)
Lasmigona subviridis (Conrad 1835)									X	(19)
	6	1	2	3	29	15	22	1	1	

NOTES

(1) These four species are part of the Ozarkian fauna.

(2) *Fusconaia barnesiana* (Lea 1838). Ortmann (1918: 536, 537) recognized two additional forms: *bigbyensis* (Lea 1841) and *tumescens* (Lea 1845).

(3) *Quadrula tuberosa* (Lea 1840). Not in Burch (1975). *Unio tuberosus* Lea 1840, Proc. Amer. Philos. Soc. *1*: 286 (Caney Fork [of the Cumberland River] and Cumberland River, Middle Tennessee); 1842, Trans. Amer. Philos. Soc. *8*: 210, pl. 14, fig. 25, figured holotype USNM 84219; 1842, Obs. Unio *3*: 48. Ortmann (1918: 540) regarded *Unio intermedius* Conrad 1834 (Tennessee River system), as being

the same as *Unio tuberosus* Lea 1840 (Cumberland River system), and *Unio sparsus* Lea 1841 (Tennessee River system). An examination of more recently collected material indicates that while *sparsus* is a synonym of *tuberosa*, as is *Quadrula biangulata* Morrison 1942 (Tennessee River, Tuscumbia, Colbert Co., Tennessee, holotype USNM 84221 figured by Johnson (1975a: 25, pl. 3, fig. 3), *Quadrula intermedia* (Conrad 1836), is a distinct species restricted to the Tennessee River system. Stansbery (1970: 13), writing on species in the Tennessee River system, in addition to *intermedia*, recognized *Quadrula sparsa* (Lea) as valid, and mentioned that, "this form [*sparsa*] stands between *Q. metanevra* and *Q. intermedia* and merges with neither."

(4) *Pleurobema oviforme* (Conrad 1834). Ortmann (1918: 552, 524 recognized two additional forms: *argenteum* (Lea 1841) and *holstonense* (Lea 1840).

(5) *Alasmidonta raveneliana* (Lea 1834). *Alasmodon atropurpureum* Rafinesque 1831 (Morrison, 1969: 24). Ortmann (1918: 562) recognized Rafinesque's taxa, but later Ortmann and Walker (1922: 39) declared *atropurpureum* an unidentified form. A. H. Clarke (pers. comm.) regards *raveneliana*, from the upper Tennessee River system, and *atropurpureum*, from the upper Cumberland River system, as distinct species, possibly since some specimens from the latter river system show a slight rugosity on the posterior slope.

(6) *Actiononais pectorosa* (Conrad 1834). *Lampsilis sowerbyana* Frierson 1927, Check list N American naiades, p. 69 (Duck River, Tennessee; based on the figure in Sowerby, 1868, Conch. Iconica *16, Unio*, pl. 63, fig. 316, holotype [lost] *teste* Johnson, 1972, Occ. Pap. Moll. 3: 149, pl. 28, fig. 3 [from Sowerby]).

(7) *Medionidus conradicus* (Lea 1834). Ortmann (1918: 575) as *plateolus* (Rafinesque 1831). *Medionidus* was monographed (Johnson 1977, [*conradicus*] p. 165, pl. 18, figs. 1, 2).

(8) *Villosa taeniata* (Conrad 1834). *Obliquaria teneltus* Rafinesque 1820 (Morrison, 1969: 24).

(9) *Villosa trabalis* (Conrad 1834). Stansbery (1971: 18d, fig. 37) separated *trabalis*, from the upper Cumberland River system, Kentucky and *perpurpurea* (Lea 1861) (fig. 38), from the Clinch drainage of the upper Tennessee River system, Virginia and Tennessee, possibly because specimens from the latter locality sometimes have violet nacre.

(10) *Dromus dromas* (Lea 1834). Ortmann (1918: 566) recognized an additional form: *caperatus* (Lea 1845).

(11) *Fusconaia cuneolus* (Lea 1840). Ortmann (1918: 531) recognized an additional form: *appressa* (Lea 1871).

(12) *Fusconaia edgariana* (Lea 1840). Not in Burch (1975). *Non Unio cor* Conrad 1834, *teste* Ortmann (1925: 330). Ortmann (1918: 533) recognized an additional form: *analoga* Ortmann 1918. The holotype of *Fusconaia edgariana analoga* Ortmann British Museum (Nat. Hist.) 1964117 was figured by Johnson (1977b: 236, pl. 27, fig. 1).

(13) *Lexingtonia dolabelloides* (Lea 1840). Ortmann (1918: 546) recognized an additional form: *conradi* (Vannata 1915).

(14) *Lasmigona holstonia* (Lea 1838). *Alasmidon badium* Rafinesque 1831 (Morrison 1969: 23).

(15) *Lampsilis virescens* (Lea 1858). Not in Burch (1975). Figured by Stansbery (1971: 183, fig. 40).

(16) *Carunculina cylindrella* (Lea 1868). Not in Burch (1975). Ortmann (1918: 573) did not recognize this taxon, but later, Ortmann (1925: 353) accepted it as a form of *C. maestus* (Lea 1841). Included, here, on the authority of Stansbery (1971: 18e, fig. 39), and Ahlstedt and Brown (1980, pp. 41, 43).

(17) *Pleurobema gibberum* (Lea 1838). Not in Burch (1975). *Unio gibber* Lea 1838, Trans. Amer. Philos. Soc. 6: 35, pl. 10, fig. 30 (Caney Fork [of Cumberland River], Tennessee, figured holotype USNM 84544); 1838, Obs. Unio 2: 35. Apparently restricted to the type locality.

(18) *Villosa ortmanni* (Walker 1925). This species is very close to *vanuxemensis* (Lea 1838), if, indeed, it is distinct.

(19) *Lasmigona subviridis* (Conrad 1835). This is the dominant species in the Greenbrier and New rivers of the Kanawha River system, West Virginia. Ortmann (1913: 371) suggested that his species originated in this system. With this exception, its distribution is entirely on the Atlantic slope and in the St. Lawrence River system.

Additional Notes

Alasmidonta minor (Lea 1845) was recognized by Ortmann (1918: 560) as a Cumberlandian species. Ortmann (1926: 167) later declared that it was, "an absolute synonym of *A. calceolus* (Lea 1829)." See under: 24. *Alasmidonta calceolus* in List 1. *Villosa nebulosa* (Conrad 1834) was recognized by Ortmann (1924a: 42) as a Cumberlandian species. Ortmann (1926: 180) later conceded that *nebulosa* and *iris* (Lea 1829) were the same species, but mistakenly thought that Conrad's name was the earlier. See under 68. *Villosa iris* in List 1.

5. *Fusconaia subrotunda* (Lea 1831)
Unio kirtlandianus Lea 1834; *Unio lesueurianus* Lea 1840; *Unio pilaris* Lea 1840; *Unio bursapastoris* Wright 1896; *Quadrula kirtlandiana minor* Simpson 1900, lectotype USNM 150155, selected by Johnson (1975a: 15, pl. 3, fig. 5); *Pleurobema missouriensis* Marsh 1901, Nautilus **15:** 74 (Black River, near Poplar Bluff, Missouri, holotype MZUM 38855 figured by Walker, 1915, Nautilus **28:** 140, pl. 5, figs. 1–2). Walker also determined that the shell was an ecophenotype of *subrotunda,* which occurs only in the Cumberlandian and Ohioan regions; *Fusconaja* [sic] *subrotunda leucogona* Ortmann 1913, lectotype CM 61.5239 selected by Johnson (1977: 238, pl. 27, fig. 2). *Fusconaia maculata maculata* (Rafinesque 1820). So listed by Taylor (1980a) on the authority of Stansbery who, apparently by some undisclosed means, has been able to identify *Elliptio nigra maculata* Rafinesque as *Fusconaia subrotunda* (Lea).

6. *Fusconaia undata* (Barnes 1823)
Obliquaria lateralis Rafinesque 1820 (Morrison, 1969: 24); *Unio trigonus* Lea 1831; *Unio friersoni* B. H. Wright 1896, Nautilus **9:** 134, pl. 3 (Bayou Pierre, an arm of the Red River, in De Soto Parish, Louisiana. "The type locality has been drained," *teste* Frierson, 1927, Check list N American naiades, p. 54. Lectotype USNM 133432 selected by Johnson, 1967, Occ. Papers on Moll. **3:** 6, pl. 5, fig. 4); *Unio askewi* Marsh 1896, Nautilus **10:** 91, pl. 1, figs. 3, 4 (Village Creek, Hardin Co.; Sabine River; *both* Texas. Figured holotype ANSP 70448a from the latter locality). Placed with *undata* by Ortmann (1914, Nautilus **28:** 20); *Fusconaia selecta* Wheeler, 1914, Nautilus **28:** 76, pl. 4 (Cache River, Nemo, Craighead Co., Arkansas; holotype [retained by Wheeler, possibly now in the Alabama Mus. Nat. Hist.]; paratypes MZUM 38300); *Fusconaia undata trigonoides* 'Frierson' Utterback 1915; *Fusconaia undata wagneri* Baker 1928.

7. *Quadrula cylindrica* (Say 1817)
Unio strigillatus Wright 1898. Known from the Cumberlandian and Ohioan regions, and from the Ozarkian Region below the Ozark Crest.

Specimens Examined

Ozarkian Region

Black River System

Ouachita River Drainage. *Arkansas:* Ouachita River, 3 mi. SE Pencil Bluff, Montgomery Co.; Ouachita River, Arkadelphia Clark Co.; (*both* MCZ).

Saline River Drainage. *Arkansas:* Saline River, Benton, Saline Co. (MCZ, CM).

Arkansas River System

Fall River Drainage. *Kansas:* Fall River, Wilson Co. (MCZ).

Verdigris River Drainage. *Kansas:* Verdigris River, Neodesha, Wilson Co. (MCZ).

Neosho River Drainage. *Kansas:* Neosho River, 3 mi. E Oswego, Labette Co. (Murray and Leonard); Neosho River, near state line (CM). *Oklahoma:* Neosho River, Miami, Ottawa Co. (CM).

Spring River Drainage. *Missouri:* Spring River, Carthage (MCZ); Center Creek, Webb City (CM); *both* Jasper Co.

White River System

White River Drainage. *Missouri:* White River, Hollister, Taney Co. (Utterback). *Arkansas:* White River, Cotter (MCZ, CM); North Fork White River, Norfolk (CM); *both* Baxter Co.

Big Buffalo Fork Drainage. *Arkansas:* Big Buffalo Fork, Newton, Sear-

cy, and Marion Cos. (*all* Meek and Clark).

Black River Drainage. *Missouri:* Black River, Williamsville, Wayne Co. (MCZ). *Arkansas:* Black River, Pocahontas, Randolph Co. (MCZ); Black River, Black Rock, Lawrence Co. (MCZ, CM).

Spring River Drainage. *Arkansas:* Spring River, Ravenden (Murray and Leonard); Spring River, Black Rock (MCZ); *both* Lawrence Co.

St. Francis River System

St. Francis River Drainage. *Missouri:* St. Francis River, Greenville, Wayne Co. (Utterback).

8. *Quadrula metanevra* (Rafinesque 1820)
Unio wardii Lea 1861.

9. *Quadrula nodulata* (Rafinesque 1820)
Unio pustulatus Lea 1831.

10. *Quadrula pustulosa* (Lea 1831)
Obliquaria bullata Rafinesque 1820 (Morrison 1969: 24); *Unio schoolcraftensis* Lea 1834; *Unio kieneri-anus* Lea 1852; *Unio asperatus* Lea 1861; *Unio refulgens* Lea 1868.

11. *Quadrula quadrula* (Rafinesque 1820)
Studied by Neel (1941) who included as synonyms: *Unio rugosus* Barnes 1823; *Unio lachrymosus* Lea 1828; *Unio asperrimus* Lea 1831; *Unio fragosus* Conrad 1836. Also included here as synonyms are *Unio asper* Lea 1831; *Unio prasinus* Conrad 1834; *Unio nobilis* Conrad 1854; *Quadrula quadrula contrayensis* Utterback 1915; *Quadrula quadrula bullocki* Baker 1928.

12. *Tritogonia verrucosa* (Rafinesque 1820)
Unio tuberculatus Barnes 1823.

13. *Megalonaias gigantea* (Barnes 1823)
Elliptio nervosa Rafinesque 1820 (Morrison 1969: 24); *Unio heros* Say 1829.

14. *Cyclonaias tuberculata* (Rafinesque 1820)
Unio graniferus Lea 1838; *Quadrula granifera pusilla* Simpson 1900, lectotype MCZ 20176, selected by Johnson (1966: 131, pl. 2, fig. 4); *Quadrula tuberculata utterback-iana* Frierson 1927.

15. *Elliptio crassidens crassidens* (Lamarck 1819)
Elliptio nigra Rafinesque 1820.

16. *Elliptio dilatata* Rafinesque 1820
Unio gibbosus Barnes 1823; *Unio subgibbosus* Lea 1837; *Unio gibbo-sus delicatus* Simpson 1900; *Elliptio dilatatus sterkii* Grier 1918.

17. *Hemistena lata* (Rafinesque 1820).

18. *Plethobasus cooperianus* (Lea 1834)
Obovaria striata Rafinesque 1820 (Morrison, 1969: 24).

19. *Plethobasus cyphyus* (Rafinesque 1820)
Unio aesopus Green 1827; *Unio compertus* Frierson 1911. Reported below the Ozark Crest from the Verdigris River, Coffeyville, Montgomery Co., Kansas. This record from the Arkansas River system was based on 3 specimens. The one in the R. E. Call collection is neither at Washburn University, Topeka, Kansas nor in the Museum of Comparative Zoology. The single valve, thought to be extant, figured by Murray and Leonard (1962: pl. 4), was sent to the National Museum of Natural History (Leonard, pers. comm., 1979), but it is not there now (Clarke, pers. comm., 1979). Branson (1967: 282) reported *P. cyphyus* from 3 localities in the Spring River of the Neosho River drainage of the Arkansas River system. These specimens could not be located at the Pittsburg [Kansas] State University (Kelting and Branson, pers. comms., 1979).

20. *Plethobasus cicatricosus* (Say 1829)
Obovaria pachosteus Rafinesque

1820 (Morrison, 1969: 24); Not in Burch (1975). See: Simpson (1914, **2:** 807), figured by Stansbery (1971, fig. 24).

21. *Pleurobema clava* (Lamarck 1819)
Not found on either side of the Ozark Crest. The several records from the Mississippian Region could not be verified, and are probably spurious. This is an Ohioan species.

22. *Pleurobema cordatum* (Rafinesque 1820)
Stansbery (1967) sent 2 pages of mimeographed ephemera on the *Pleurobema cordatum* complex to interested parties. Since he later (1970: 21) included this work in his bibliography, it is essentially quoted and discussed as if it were validly published, with additional comments in brackets. He recognized 4 species, one possibly undescribed.

(1). *Pleurobema cordatum* (Rafinesque 1820). Outline: equilateral triangle.
Unio obliqua Lamarck 1819. Unidentifiable [=*cordatum* Rafinesque (Morrison, 1969: 24). Johnson (1969, Nautilus **83:** 54) substantiated Stansbery's opinion that *obliqua* is unrecognizable].
Obovaria cordata Rafinesque 1820
Unio plenum Lea 1840. Specimen with shortened posterior [is *Pleurobema premorsa* Rafinesque 1831 (Morrison, 1969: 24)].

(2). *Pleurobema coccineum* (Conrad 1836). Outline: subcircular.
Unio coccineus Conrad 1836. Compressed with red nacre.
Unio catillus Conrad 1836. Moderately wide specimen—medium rivers.
Unio coccineum Lea 1838. Moderately wide specimen—medium rivers.
Unio solidus Lea 1838. Very wide specimen—large rivers [is *sintoxia* (Rafinesque 1820) (Morrison, 1969: 24)].
Unio cuneus Conrad 1838 (?) A wide "dwarfed" specimen.
Unio gouldianus Ward 1839. Specimen with white nacre.
Unio fulgidus Lea 1845. Moderately wide specimen—quite young.
Quadrula coccinea paupercula Simpson 1900. Stunted "Lake Erie" specimen [Lectotype USNM 134834, selected by Johnson, 1975a; 17, pl. 3, fig. 1, non *Unio paupercula* Lea 1861, unnecessarily changed by Simpson (1914, Cat. Naiades **2:** 884) to *magnalacustris*].
Pleurobema coccineum mississippiensis Baker 1928 (in part). Very wide specimen(s) from Miss. River at Lake Pepin. [Havlik and Stansbery (1978: 11) recognized *P. coccineum* as a valid species.]

(3). *Pleurobema pyramidatum* (Lea 1834). Outline: scaline triangle.
Unio pyramidatus Lea 1834 [Is *P. obliquata* (Rafinesque 1820) (Morrison, 1969: 24)]; *Unio mytiloides* Rafinesque 1820. Conrad 1836. Actually *P. clava* (Lamarck 1819).
Unio cardiacea Guerin [1829]
Pleurobema coccineum mississippiensis Baker 1928 (in part). Well developed specimen(s) from Miss. River at Lake Pepin. [Havlik and Stansbery (1978: 11) recognized *P. rubrum* (Rafinesque 1820) = *pyramidatus* Lea 1831, possibly on the basis of Ortmann's (1918: 550) recognition of *Pleurobema obliquum rubrum* (Rafinesque) and the subsequent selection of a lectotype for it, ANSP 20237, figured by Johnson and Baker (1973: 169, pl. 3, fig. 2)].

(4). *Pleurobema* ... (undescribed). Outline: isosceles triangle.

The taxa under *cordatum* and *pyramidatum* are usually associated with specimens from large rivers, while specimens that lose their sinus and become rounded with an elongated posterior end, from smaller streams and headwaters, have been incorrectly called *P. cordatum coccineum*.

[*Pleurobema cordatum* is a species with a number of ecophenotypic forms which are not species or subspecies in the modern sense. Note: *Pleurobema missouriensis* Marsh 1901. See under no. 5, *Fusconaia subrotunda* (Lea 1831)].

23. *Uniomerus tetralasmus* (Say 1831)
Unio camptodon Say 1832; *Unio sayi* Ward 1839. For the complete synonymy see: Johnson (1970: 339).

White River System

White River Drainage. *Arkansas:* Cache River, Nemo, Craighead Co. (Wheeler, 1914, Nautilus **28:** 76).

Previously unreported from the Tennessee River system. Found in Kentucky Lake, Little Eagle Creek embayment, Benton Co. in 1971 and Hurricane Creek, Henderson and Hardin Cos. in 1977; *both* Tennessee (Brown and Pardue, in press). Like *Arcidens confragosus*, no. 32, it is suggested here that *tetralasmus* was accidentally introduced behind the impoundment with fishes.

24. *Alasmidonta calceolus* (Lea 1830)
Anodonta viridis Rafinesque 1820 (Morrison, 1969: 23); *Margaritana minor* Lea 1845; *Alasmidonta calceolus danielsi* Baker 1928; *Alasmidonta calceolus magnalacustris* Baker 1928.

25. *Alasmidonta marginata* Say 1819
Margaritana marginata truncata Wright 1898; *Alasmidonta marginata variabilis* Baker 1928.

26. *Anodonta grandis grandis* Say 1829
Anodonta plana Lea 1834; *Anodonta stewartiana* Lea 1834; *Anodonta gigantea* Lea 1838; *Anodonta footiana* Lea 1840; *Anodonta virens* Lea 1852; *Anodonta opacea* Lea 1856; *Anodonta leonensis* Lea 1857; *Anodonta danielsii* Lea 1858; *Anodonta texasensis* Lea 1859; *Anodonta bealii* Lea 1863; *Anodonta dakota* Frierson 1910.

27. *Anodonta corpulenta* Cooper 1834
Regarded as a subspecies by Burch (1973: 17; 1975: 15) and Havlik and Stansbery (1978: 15). *A. corpulenta* has not been regarded as a subspecies in the modern sense, as a geographically isolated population. It is either a synonym of *grandis*, or more probably, it is a valid species.
Found in the Meramec Basin, Missouri. (Buchanan, pers. comm.).

28. *Anodonta imbecillis* Say 1829
Anodonta ohiensis Rafinesque 1820 [of authors]; *Utterbackia imbecillis fusca* Baker 1928. In spite of the statements by various authors, the original orthography is with the double "l".
Range extension on the North Atlantic Slope:

Delaware River System

Schuylkill River Drainage. *Pennsylvania:* Pickering Creek, Chester Co. (Fuller and Hartenstine, 1980). [most probably a recent introduction].

29. *Anodonta suborbiculata* Say 1831
See under species monographed.

30. *Anodontoides ferussacianus* (Lea 1834)
Anodonta subcylindracea Lea 1838; *Anodonta modesta* Lea 1857; *Anodontoides bergei* Baker 1928.

Meramec River System

Bourbeuse River Drainage. *Missouri*: Dry Fork Creek [Maries and Gasconade Cos.]; Brush Creek [Gasconade and Crawford Cos.]; (*both* Ohio State Museum, *teste*, Buchanan, pers. comm.).

White River System

Little Red River Drainage. *Arkansas*: Little Red River, Clinton, Van Buren Co. (E. Pleas, MZUM, *teste* Gordon, pers. comm.) Listed by Gordon, *et al.* (1980: 35).

St. Francis River System

St. Francis River Drainage. *Arkansas*: St. Francis River, Marked Tree, Poinsett Co. (M. Ellis, MZUM, *teste* Gordon, pers. comm.) Listed by Gordon, *et. al.* (1980: 35).

31. *Arcidens confragosus* (Say 1829)
Previously unreported from the Tennessee River system. Found in: Kentucky Lake, 6 mi. above New Johnsonville, Benton Co., Tennessee, collected in 1967 by Stansbery and Jenkinson. It is suggested that it was accidentally introduced behind the impoundment with fishes. See under species monographed.

32. *Lasmigona complanata* (Barnes 1823)
Unio katherinae Lea 1838
Previously unreported from the Ozarkian Region below the Ozark Crest.

White River System

Black River Drainage. *Missouri:* Black River, Hendrickson, Butler Co. (MCZ 260973).

33. *Lasmigona compressa* (Lea 1829)
Not found on either side of the Ozark Crest.
Not found in the Illinois River, proper, but recorded from its tributaries. *Illinois:* Vermilion River; Panther Creek, Woodford Co. (*both* Parmalee, 1967: 53, pl. 17, A).

34. *Lasmigona costata* (Rafinesque 1820)
Lasmigona costata pepinensis Baker 1928; *Lasmigona costata nuda* Baker 1928.

35. *Simpsoniconcha ambigua* (Say 1825)

White River System

Little Red River Drainage. *Arkansas:* Little Red River, Clinton, Van Buren Co. (E. Pleas, USNM, *teste*, Gordon, pers. comm.). Listed by Gordon, *et al.* (1980: 35).

Meramec River System

Bourbeuse River Drainage. *Missouri:* Bourbeuse River, 0.1 mi. S. Tea (Buchanan, Ohio State Museum). Buchanan allowed the author to examine an authentic specimen from this lot.

St. Lawrence River System

Great Lakes Drainage (Lake Michigan). *Wisconsin:* Wolf River, Shawanao Co. (Mathiak, 1979, p. 62, pl. 9, A, single specimen).

36. *Strophitus undulatus* (Say 1817)
Anodon rugosus Swainson 1822; *Alasmidonta edentula* Say 1829; *Anodonta parvonia* Lea 1836; *Strophitus undulatus tennesseensis* Frierson 1927; *Strophitus undulatus ovatus* Frierson 1927; *Strophitus rugosus pepinensis* Baker 1928; *Strophitus rugosus winnebagoensis* Baker 1928; *Strophitus rugosus lacustris* Baker 1928.

37. *Actinonaias ligamentina* (Lamarck 1819)
Unio carinatus Barnes 1823, *teste* Morrison (1969: 24). Lamarck's holotype of *Unio ligamentina* was figured by Johnson (1969, Nautilus **83:** 53; fig. 8); *Lampsilis ligamentinus*

gibbus Simpson 1900, figured holotype British Museum (Nat. Hist.) 107.10.28.262; *Lampsilis ligamentinus nigrescens* Simpson 1914, lectotype USNM 150410, selected by Johnson (1975a: 13, pl. 1, fig. 2); *Actinonaias carinata orbis* Morrison 1942, holotype USNM 85998, figured by Johnson (1975a: 32, pl. 1, fig. 3).

38. *Actinonaias ellipsiformis* (Conrad 1836)
Unio venustus Lea 1838; *Unio pleasi* Marsh 1891, Nautilus **5:** 2 (Little Red River, Arkansas, lectotype ANSP 56480a selected by Johnson and Baker, 1973, Proc. Acad. Nat. Sci. Phila. **125:** 166, pl. 9, fig. 5). Found in the streams of the southern half of the Lower Michigan Peninsula which flow into Lake Michigan. During periods of confluence, it entered the Saginaw River drainage, but it has not migrated into any of the streams of southeastern Michigan draining into Lake St. Clair or Lake Erie (van der Schalie, H. and A., 1963: 9).

39. *Carunculina parva* (Barnes 1823)
Unio texasensis Lea 1859; *Unio cromwelli* Lea 1865; *Carunculina parva calni* Baker 1927.

40. *Carunculina glans* (Lea Dec. 1831)
Toxolasma livida Rafinesque 1831 (Morrison, 1969: 24). Not in Burch (1975). See: Simpson (1914, **1:** 153). Stansbery (1970): 18) recognized *moaesta* (Lea) as a form or subspecies, which "exists in . . . several headwater streams of the Cumberland Plateau and the Southern Appalachians." Reported by Call (1885a: 31) as from the Green and Kentucky rivers, based on MCZ 5410, two specimens, so labeled. These are regarded here as erroneous records. Known from the Cumberlandian and Ohioan regions, and from the Ozarkian Region below the Ozark Crest.

Specimens Examined

Ozarkian Region

Black River System

Ouachita River Drainage. *Arkansas:* Caddo River, near Arkadelphia; Ouachita River and Old River, near Arkadelphia; Terra Noire Creek, Mt. Zion; *all* Clark Co. (*all* Wheeler, 1918: 119).

Arkansas River System

Spring River Drainage. *Missouri:* Spring River, Carthage, Jasper Co. (MCZ).

Elk River Drainage. *Missouri:* Elk River, [McDonald Co.] (Utterback).

White River System

White River Drainage. *Arkansas:* White River, Carroll Co.; James Fork of White River, Galena, Stone Co.; (*both* MCZ).

Big Buffalo Fork Drainage. *Arkansas:* Big Buffalo Fork, Searcy Co. (Meek and Clark).

Little Red River Drainage. *Arkansas:* Little Red River (MCZ).

41. *Plagiola triquetra* (Rafinesque 1820)
Found below the Ozark Crest only in the

White River System

Black River Drainage. *Missouri:* [Black River]. Poplar Bluff, [Butler Co.], (MZUM). Based on a single specimen, the locality written on the shell, with the additional data [W. A.] Marsh, March 3, 1891. This record may be spurious as is that of *Pleurobema missouriensis* Marsh 1901. See also under: no. 5. *Fusconaia subrotunda* (Lea 1831). *P. triquetra* was not listed from the Kentucky River system by Johnson (1978). Now recorded from: South Fork Kentucky River, Booneville, Ousley Co.,

Kentucky (MCZ). Found in the Muskegon, Grand and St. Joseph rivers on the eastern side of Lake Michigan, but not in the Lake proper (Johnson, 1978: 292).

42. *Plagiola torulosa* (Rafinesque 1820)
Found in the Grand River on the eastern side of Lake Michigan, but not in the Lake proper (Johnson, 1978: 296).

43. *Plagiola sampsoni* (Lea 1861)
See: (Johnson, 1978, pl. 6, fig. B, triangles).

44. *Plagiola propinqua* (Lea 1857)
See: (Johnson 1978, pl. 6, fig. B, dots).

45. *Plagiola personata* (Say 1829)
See: (Johnson, 1978, pl. 6, fig. A).

46. *Plagiola obliquata* (Rafinesque 1820)
Unio sulcatus Lea 1829.

47. *Plagiola flexuosa* (Rafinesque 1820)
Rafinesque's records: Green, Salt, and Kentucky rivers, are spurious. See: (Johnson, 1978, pl. 5).

48. *Ellipsaria lineolata* (Rafinesque 1820)
Unio securis Lea 1829.

49. *Lampsilis teres* (Rafinesque 1820)
The availability of *teres* over *anodontoides* Lea 1834 and *fallaciosus* Smith 1899 was discussed by Johnson (1972: 244). This discussion was ignored by Morrison (1979: 61) who regarded *teres* and *anodontoides* as separate species.

50. *Lampsilis fasciola* (Rafinesque 1820)

51. *Lampsilis higginsi* (Lea 1857)
Not in Burch (1975). See under species monographed.

52. *Lampsilis abrupta* (Say 1831)
Listed by Burch (1975) as *orbiculata* (Lea 1836) non Hildreth 1828. See under species monographed.

53. *Lampsilis ovata* (Say 1817)
Lampsilis cardium Rafinesque 1820; *Unio ventricosus* Barnes 1823; *Unio occidens* Lea 1829; *Unio canadensis* Lea 1857; *Lampsilis ventricosa lurida* Simpson 1914; *Lampsilis ventricosa perglobosa* Baker 1928; *Lampsilis ventricosa winnebagoensis* Baker 1928. *L. ventricosa* Barnes is regarded as a valid species by Havlik and Stansbery (1978: 11). For a discussion of ecophenotypic variation in *L. ovata* see: Johnson (1970: 388).

54. *Lampsilis radiata siliquoidea* (Barnes 1823)
Unio luteola Lamarck 1819 (Morrison, 1969: 24); *Unio rosacea* DeKay 1843; *Unio superiorensis* Marsh 1897; *Lampsilis siliquoidea pepinensis* Baker 1927; *Lampsilis siliquoidea chadwicki* Baker 1928. Johnson (1969, Nautilus **83:** 54, fig. 11) figured the type of *Unio luteola* and restricted the type locality to the Susquehanna River, Columbia, York Co., Pennsylvania. This choice from the two localities given by Lamarck, placed the equivocal type in the Atlantic Slope Region where only the typical form is found. See: Clarke and Berg (1959: 60; 80) who define *siliquoidea* as a subspecies in the modern sense. *L. radiata siliquoidea* has never been reported from the Tennessee or Cumberland River systems.

55. *Leptodea fragilis* (Rafinesque 1820)
Lampsilis simpsoni Ferriss 1900, Nautilus **14:** 38, fig. (Spring River, Hardy [Sharp Co.], Arkansas, figured holotype Field Mus. Nat. Hist. [not seen]); such specimens, without a dorsal "wing" are found throughout the range of *L. fragilis*; *Leptodea fragilis lacustris* Baker 1922.

56. *Leptodea laevissima* (Lea 1829)
Potamilus ohiensis (Rafinesque 1820) (Morrison, 1969: 24). Originally described as *Anodonta ohiensis* (*Lastena ohiensis*).

57. *Leptodea leptodon* (Rafinesque 1820)
Lampsilis blatchleyi Daniels 1902, Nautilus **16:** 13, pl. 2 (Wabash River, Section 32, Lynn Township, Posey Co., Indiana; holotype MZUM 82660). Known only from the type lot. It was suggested by Goodrich and van der Schalie (1944: 317) to be a form of *leptodon*.

58. *Ligumia recta* (Lamarck 1819)
Elliptio latissima Rafinesque 1820; *Unio sageri* Conrad 1831.

59. *Ligumia subrostrata* (Say 1831)
Lampsilis subrostrata furva Simpson 1914, lectotype USNM 126921, selected by Johnson (1975a: 13, pl. 1, figs. 4, 6).

60. *Obovaria olivaria* (Rafinesque 1820)
Unio ellipsis Lea 1828.

61. *Obovaria retusa* (Lamarck 1819)

62. *Obovaria subrotunda* (Rafinesque 1820)
Elliptio levigata Rafinesque 1820; *Unio lens* Lea 1831; *Obovaria lens parva* Simpson 1914, lectotype USNM 150457 selected by Johnson (1975a: 16, pl. 1, fig. 8); *Obovaria lens elongata* Simpson 1914, lectotype USNM 35734, selected by Johnson (1975a: 12, pl. 1, fig. 9; *Quadrula subrotunda globula* Morrison 1942, holotype USNM 85789, figured by Johnson (1975a: 29, pl. 1, fig. 7).

63. *Proptera alata* (Say 1817)
Metaptera megaptera Rafinesque 1820. Found below the Ozark Crest only in the Neosho River drainage of the Arkansas River system. (Scammon, 1906: 300; Murray and Leonard, 1962: 129).

64. *Proptera capax* (Green 1832)
Published records from the Arkansas River system are in error. See under species monographed.

65. *Truncilla truncata* Rafinesque 1820
Non *Unio truncatus* Spengler 1793; *Unio elegans* Lea 1831; *Truncilla truncata lacustris* Baker 1928.

66. *Truncilla donaciformis* (Lea 1828)

67. *Villosa fabilis* (Lea 1831)

68. *Villosa iris* (Lea 1829)
Unio nebulosus Conrad 1834, the records under this name from the Cumberlandian Region are *iris*. The type locality of *nebulosus* is: Black Warrior River [Mobile-Alabama-Coosa River system], Alabama, and it may be a valid species; *Unio ellipsiformis* Conrad 1836; *Unio novieboraci* Lea 1838.

69. *Villosa lienosa* (Conrad 1834)
Range extended into Ohio and West Virginia. Based on records in Jenkinson and Kokai (1978).

70. *Cyprogenia stegaria* (Rafinesque 1820)
See under species monographed.

71. *Obliquaria reflexa* Rafinesque 1820

72. *Ptychobranchus fasciolare* (Rafinesque 1820)
Not found in the Mississippian Region. Valentine and Stansbery (1971: 23) claim that there are specimens of this species in the Ohio State Museum from Missouri. These are probably *P. occidentalis* (Conrad).

UNIONIDAE OF THE OZARKIAN REGION WITH DISTRIBUTIONS NOT EXTENDING INTO THE MISSISSIPPIAN OR OHIOAN REGIONS [List 2]

I. *Fusconaia ozarkensis* (Call 1888)
Not in Burch (1975).
See under species monographed.

II. *Plectomerus dombeyanus* (Valenciennes 1827)
Unio trapezoides Lea 1831.

III. *Quadrula apiculata* (Say 1829)
Not in Burch (1975). Studied by Neel (1941: 4, pl. 1, figs. 5–12) who regarded *apiculata* as a subspecies of *Quadrula quadrula*.

They appear to be separate species with an overlapping distribution in the Gulf Coastal Region.

IV. *Arkansia wheeleri* Ortmann and Walker 1912
See under species monographed.

V. *Actinonaias rafinesqueana* (Frierson 1927)
Not in Burch (1975).
See under species monographed.

VI. *Plagiola florentina* (Lea 1857)
Truncilla curtisii Frierson and Utterback 1916, Amer. Mid. Nat. **4:** 453 [190], pl. 6, figs. 14 a–d, pl. 28, figs. 109 A–D (White River, Hollister, [Taney Co.], Missouri, lectotype MZUM 90748, selected by Johnson, 1978, Bull. Mus. Comp. Zool. **148:** 272, pl. 13, fig. 10).
See: (Johnson, 1978, pl. 2, dots).

VII. *Plagiola turgidula* (Lea 1858)
Truncilla lefevrei Utterback 1916, Amer. Mid. Nat. **4:** 455 [192], pl. 6, figs. 13 a–d, pl. 28, figs. 108 A–D (Black River, Williamsville, [Wayne Co.], Missouri, figured syntypes [lost]).
See: (Johnson, 1978, pl. 2, triangles).

VIII. *Glebula rotundata* (Lamarck 1819)
Unio suborbiculata Lamarck 1819.

IX. *Lampsilis excavata* (Lea 1857) Plate 15, figures 1, 2.
Several lots collected in the Black River system by the joint Harvard-Ohio State Museum expedition, 1964, confirmed the authenticity of older records from the Saline River, Benton, Saline Co., Arkansas.

X. *Lampsilis satur* (Lea 1852) Plate 14, figures 1, 2.
Unio satur Lea 1852, Trans. Amer. Philos. Soc. **10:** 205, pl. 17, fig. 19 ([Red River], Alexandria, [Rapides Parish], Louisiana; holotype USNM 84505); 1852, Obs. Unio **5:** 21.
Lampsilis ventricosa satur (Lea). Simpson, 1900, Proc. U. S. Natl. Mus. **22:** 527; 1914, Cat. Naiades **1:** 41.
Not in Burch (1975). Ortmann (1916, Nautilus **30:** 56) correctly suspected that *satur* was a valid species, distinct from *Lampsilis ovata* (Say). They occur together in the White and St. Francis river systems, but *ovata* is missing further south.

XI. *Lampsilis hydiana* (Lea 1838) Plate 15, figures 5–7.
Unio hydianus Lea 1838, Trans. Amer. Philos. Soc. **6:** 14, pl. 6, fig. 14 (Teche River, [St. Landry Parish], holotype USNM 85010; vicinity of New Orleans [Orleans Parish]; *both* Louisiana); 1838, Obs. Unio **2:** 14.
Unio placitus Lea 1852, Trans. Amer. Philos. Soc. **10:** 279, pl. 23, fig. 38 (Alabama; holotype USNM 85152) 1852, Obs. Unio **5:** 35.
Lampsilis hydiana (Lea). Simpson, 1900, Proc. U.S. Natl. Mus. **22:** 536; Cat. Naiades **1:** 66.
Simpson correctly regarded *hydiana* as a valid species distinct from *Lampsilis radiata siliquoidea* (Barnes), pointing out that *hydiana* has a more inflated shell, a more waxy texture, and that the rays are bolder, more distinct, and more brilliant. Both species occur together in the upper Arkansas, White, and St. Francis river systems, but *siliquoidea* is missing further south.

XII. *Lampsilis powelli* (Lea 1852)
Not in Burch (1975).
See under species monographed.

XIII. *Obovaria jacksoniana* (Frierson 1912)
As pointed out by Stansbery (1976: 47) *Unio castaneus* Lea December 1831 is preoccupied by *Unio castaneus* Rafinesque 1831.

XIV. *Proptera purpurata* (Lamarck 1819).

XV. *Villosa arkansasensis* (Lea 1862)
Not in Burch (1975).
See under species monographed.

XVI. *Villosa reeviana* (Lea 1852)
See under species monographed.

XVII. *Villosa vibex* (Conrad 1834) Plate 17, figures 6–8.
The synonymy was listed by Johnson (1970: 373) with the exception of:
Lampsilis streckeri Frierson 1927, Check list N American naiades, p. 74 (Little Red River, Arkansas; holotype MZUM 91075, figured by Frierson, 1928, Nautilus **41:** 139, pl. 2, fig. 1); Strecker, 1931, Baylor Univ. Mus., Special Pub. no. 2, p. 40. *Actinonaias streckeri* Valentine and Stansbery 1972, Sterkiana, no. 42, p. 32, *non* Frierson. Is *Actinonaias rafinesqueana* (Frierson 1927).
Frierson, in the original description, mentioned that the types of *streckeri* were found together with specimens of *vibex*. An examination of the type of the former with the specimens also mentioned there as from Onion Creek [of the Colorado River system], Travis Co., Texas, MZUM 79921, as *streckeri*; indicates that the "chain-like rays, sometimes becoming a ribbon or band of cross lines," which characterize *streckeri*, occur in widely separated populations of *vibex*. It is found in most coastal river systems from the Guadeloupe River system, Texas, east and north to the Cape Fear River system, North Carolina. Ozarkian region, known only from:

White River System

Little Red River Drainage. *Arkansas:* Archies Fork, Clinton (MZUM); Little Red River, Clinton (MCZ, MZUM); *both* Van Buren Co.

XVIII. *Cyprogenia aberti* (Conrad 1850)
See under species monographed.

XIX. *Ptychobranchus occidentalis* (Conrad 1836)
See under species monographed.

UNIONACEA OF THE NORTHERN ATLANTIC SLOPE REGION NORTH OF MAXIMUM PLEISTOCENE GLACIATION [LIST 3]

FAMILY MARGARITIFERIDAE

A. *Margaritifera margaritifera* (Linnaeus 1758)
Reported from the Lower Saskatchewan River by Dall, but shown to be a spurious record by Clarke (1973: 130).

FAMILY UNIONIDAE

B. *Elliptio complanata* (Lightfoot 1786)
Also found in the St. Lawrence River system and in the Ohio River system, Tuscarawas River, New Philadelphia, Tuscarawas Co., Ohio (CM). Sterki (1900: 10) suggested that it migrated from the east to Lake Erie by canals [Erie Canal] and by the Ohio Canal to the Tuscarawas River. St. Lawrence River system, not found in Lake Erie proper, but found in the Grand River, Eagleville, Ashtabula Co., Ohio (CM) (Ortmann, 1919: 110). Found in an Indian Midden ca. 1350 A.D. on the shore of the Little Miami River, Warren Co., Ohio (Russell Barber, pers. comm.). Canadian

Interior Basin, reported from the Saskatchewan River by Dall, but shown

to be a spurious record by Clarke (1973: 130).

C. *Lasmigona subviridis* (Conrad 1835)
Ortmann (1913: 371) found this to be the dominant species in the Greenbrier and New rivers of the Kanawha River system, which extends across the divide but drains to the west, into the Ohio. Ortmann thought that it spread into the Atlantic Slope region by former stream capture. With this exception, it is found only on the Atlantic slope and in the St. Lawrence drainage. It is arbitrarily regarded as an Atlantic Slope species, since it spread from there into the St. Lawrence drainage.

D. *Alasmidonta undulata* (Say 1817)

ST. LAWRENCE RIVER SYSTEM

Lake Champlain Drainage. *Vermont:* Otter Creek, Addison Co., (D. Smith, pers. comm.).

E. *Alasmidonta varicosa* (Lamarck 1819)

F. *Alasmidonta heterodon* (Lea 1830)
This species was placed in the monotypic subgenus *Prolasmidonta* by Ortmann (1914, Nautilus **28:** 44). *Prolasmidonta* was raised to generic rank by Fuller (1977: 169), based on the same data available to Ortmann. Johnson (1970: 347) maintained the subgeneric status of *Prolasmidonta.*

G. *Anodonta cataracta cataracta* Say 1817

H. *Anodonta cataracta fragilis* Lamarck 1819
marginata of authors, non Say 1817; *brooksiana* van der Schalie 1938. The concept of *fragilis* as a subspecies is based on the work of Clarke and Rick (1963: 22). The use of this combination for certain populations of *Anodonta* in the St. Lawrence River system may be suspect. The Lake Superior population, at least, might be another geographic subspecies, *A. grandis simpsoniana* Lea.

I. *Anodonta implicata* Say 1829
Morrison (1975: 36) stated that *Mytilus fucata* Dillwyn 1817 is this species, and suggested that after a century and a half of usage, Say's name should be replaced by that of Dillwyn.

J. *Strophitus undulatus* (Say 1817)
This species is ubiquitous, and is included on the list of Unionacea found in the area north of the maximum glaciation as no. 36.

K. *Ligumia nasuta* (Say 1817)

L. *Lampsilis cariosa* (Say 1817)

M. *Lampsilis ochracea* (Say 1817)
Morrison (1975: 38) stated that *Mytilus fluviatilis* Gmelin 1791 is this species, and suggested that after a century and a half of usage, Say's name should be replaced by that of Gmelin. He also removed this species from *Lampsilis,* placing it in *Leptodea.*

N. *Lampsilis radiata radiata* (Gmelin 1791)

UNIONACEA OF THE PACIFIC COASTAL REGION [List 4]

FAMILY MARGARITIFERIDAE

a. *Margaritifera falcata* (Gould 1850)
Reported from the Madison River, Montana by Stober (1972: 343) as *Margaritifera margaritifera.*

FAMILY UNIONIDAE

b. *Gonidea angulata* (Lea 1838)

c. *Anodonta beringiana* Middendorff 1851

d. *Anodonta californiensis* Lea 1852

e. *Anodonta dejecta* Lewis 1875

f. *Anodonta kennerlyi* Lea 1860

g. *Anodonta oregonensis* Lea 1838

h. *Anodonta nuttalliana* Lea 1838
Anodonta wahlamatensis Lea 1838. The first name is chosen on the basis of the page precedence.

TABLE 2

DISTRIBUTION OF UNIONACEA IN THE MISSISSIPPIAN AND OHIOAN REGIONS

A. Unionidae of the Mississippian and Ohioan regions with possible refugia adjacent to both areas.

		MISSISSIPPIAN REGION										OHIOAN REGION											
		OZARKIAN REGION						CUMBERLANDIAN REGION															
		below Ozark Crest	Black Water River **	Osage River	Gasconade River	Meramec River	Mississippi River System	Illinois River	Tennessee River	Cumberland River	Ohio River System	Wabash River	Green River	Kanawha (or New) River	Monongahela & Allegheny Rivers	Tradewater River	Salt River	Kentucky River	Licking River	Big Sandy River	Scioto River	Muskingum River	Canadian Interior Basin
2	Amblema plicata	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
12	Tritogonia verrucosa	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
63	Proptera alata	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	+	X
10	Quadrula pustulosa	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	+	
4	Fusconaia flava	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X
53	Lampsilis ovata	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X
55	Leptodea fragilis	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	+	
14	Cyclonaias tuberculata	X		X	+	X	X	X	X	X	X	X	X	X	X		+	X	+		X		
58	Ligumia recta	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X			X	X	X
26	Anodonta grandis	+	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	+		X	X	X
36	Strophitus undulatus	X	X	X	X	X	X	X	X	X	X	X	X	X	X		+	X	+		X	X	X
54	Lampsilis radiata siliquoidia	X	X	X	X	X	X	X	54	54	X	X	X	X	X		X	X	+		X	X	X
37	Actinonaias ligamentina	X		X	X	X	X	X	X	X	X	X	X	X	X		X	X	+		X	X	
16	Elliptio dilatata	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X			X	+	
22	Pleurobema cordatum	X		X	X	X	X	X	X	X	X	X	X	X	X			X			X	X	
25	Alasmidonta marginata	X		X	+	X	X	X	X	X	X	X	X	X	X			X					
15	Elliptio crassidens crassidens	X			X	X	X	X	X	X	X	X	X	X	X		+			X	X		
8	Quadrula metanerva	X				X	X	X	X	X	X	X	X	X	X				+			X	
19	Plethobathus cyphyus	X			X	X	X	X	X	X	X	X	X	X	X						X	X	
34	Lasmigona costata	X	X	X	+	X	X	X	X	X	X	X	X	X	X	X	X	X		+	X	X	X
68	Villosa iris	X				X	X	X	X	X	X	X	X	X	X						X	X	
71	Obliquaria reflexa	X		X	X	X	X	X	X	X	X	X	X	X	X		X	X	+			+	
41	Plagiola triquitra	X				X	X	X	X	X	X	X	X	X	X		X	X			X	X	
48	Ellipsaria lineolata	X	X	X	X	X	X	X	X	X	X	X	X	X	X								
49	Lampsilis teres	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	+		X	X	
65	Truncilla truncata	X		X	X	X	X	X	X	X	X	X	X	X	X		+	X	+		+	X	
32	Lasmigona complanata	+	X	X		X	X	X	X	X	X	X	X	X	X		X	X	X		X	X	X

TABLE 2. Continued

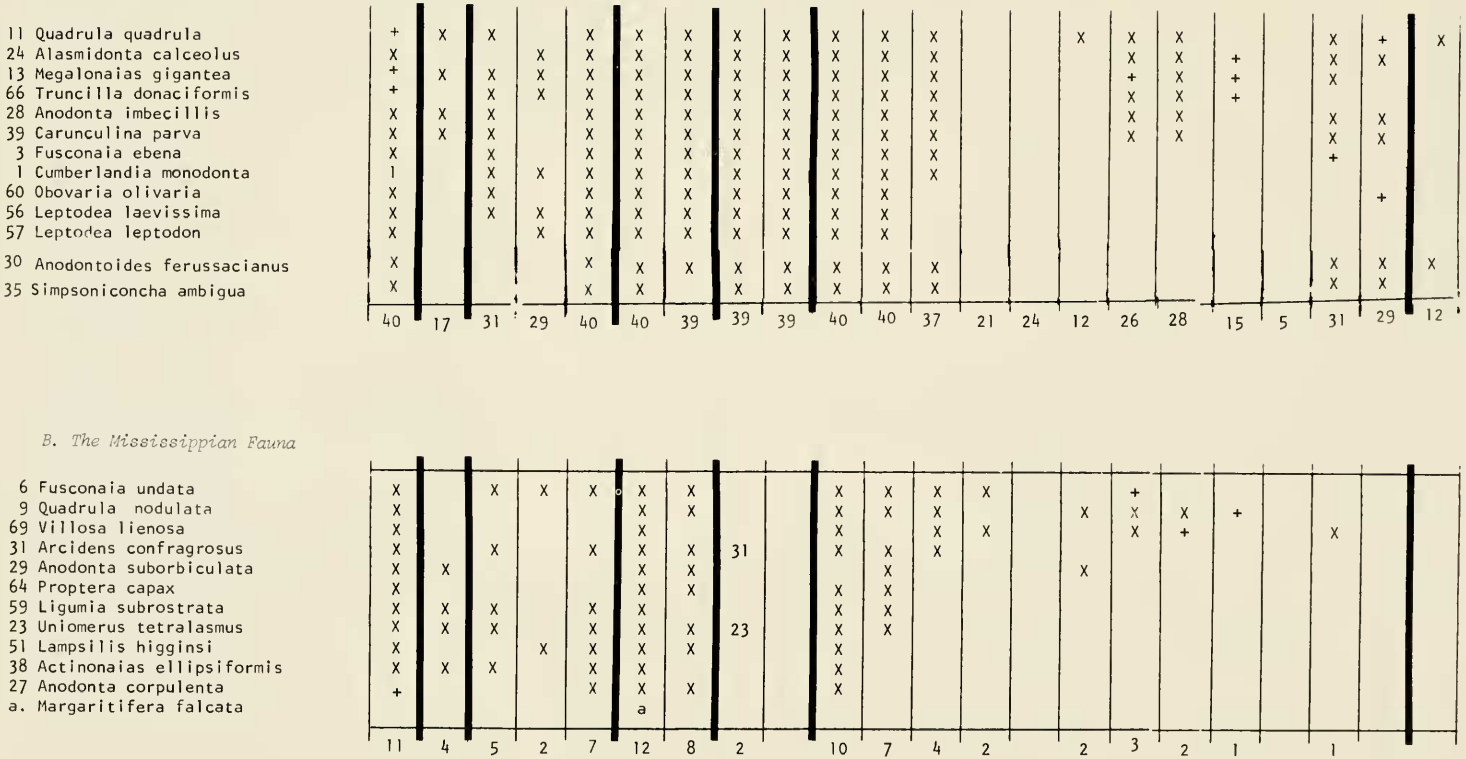


TABLE 2. Continued

		OZARKIAN REGION				MISSISSIPPIAN REGION	CUMBERLANDIAN REGION			OHIOAN REGION													
	C. The Ohioan Fauna	below Ozark Crest	Black Water River**	Osage River	Gasconade River	Meramec River	Mississippi River System	Illinois River	Tennessee River	Cumberland River	Ohio River System	Wabash River	Green River	Kanawha (or New) River	Monongahela & Allegheny Rivers	Tradewater River	Salt River	Kentucky River	Licking River	Big Sandy River	Scioto River	Muskingum River	Canadian Interior Basin
33	Lasmigona compressa						X	33	X	X	X	X			X						X	X	X
X 52	Lampsilis abrupta						X	X	X	X	X	X			X						X	X	
72	Ptychobranchus fasciolare						72		X	X	X	X	X	X	X		X	X	X		X	X	
62	Obovaris subrotunda								X	X	X	X	X	X	X		X	X		X	X	+	
21	Pleurobema clava						21		X	X	X	X	X	X	X			X			X	X	
50	Lampsilis fasciolare								X	X	X	X	X	X	X			X			X	X	
5	Fusconaia subrotunda								X	X	X	X	X	X	X					X	X	X	
70	Cyprogenia irrorata								X	X	X	X	X		X		X	X			X	X	
7	Quadrula cylindrica	X							X	X	X	X	X		X			X		X	+	X	
42	Plagiola torulosa								X		X	X	X		X			X			X	X	
67	Villosa fabilis								X		X		X	X							X	+	
17	Hemistena lata								X	X	X	X	X								X		
45	Plagiola obliquata								X	X	X	X	X						X		X		
47	Plagiola flexuosa								X	X	X	X	X					X					
18	Plethobasus cooprianus								X	X	X	X	X										
61	Obovaria retusa								X	X	X	X	X										
X 40	Carunculina glans	X							X	X	X	X											
X 20	Plethobasus cicatricosus								X	X	X	X											
X 46	Plagiola personata								X	X	X	X											
X 43	Plagiola sampsoni								X		X	X											
X 44	Plagiola propinqua								X	X	X												
8	Elliptio complanata																					X	
X Cumberlandian origin		2	0	0	0	0	1	2	20	17	21	19	14	6	10	0	3	8	2	3	13	12	2
TOTAL FROM A/B/C		53	21	36	31	47	53	48	61	56	71	66	55	29	34	14	32	38	18	8	45	41	13
TOTAL INCLUDING TABLE 1		57*		37	33	50			90	77			56	30									

*Does not include those Ozarkian species found only below the Ozark Crest

** Mississippian Region

DISTRIBUTION OF UNIONACEA IN THE MISSISSIPPIAN AND OHIOAN REGIONS [Table 2]

The number or letter preceeding the name of the species in the table refers to the designation on the several faunal lists already given.

An "X" indicates that the record was found in published works and a "+" indicates that the record is supplemental to these, based on specimens in the Museum of Comparative Zoology. A small letter, capital letter, or arabic numeral in the body of the table indicates that there are additional data in the several lists that should be consulted concerning the distribution of the species under the category in which it occurs. The rivers thought to be possible refugia for the Mississippian fauna are listed from west to east. The arrangement of the Cumberlandian and Ohioan rivers continues in the same direction but in an arbitrary fashion. The Wabash follows the Cumberlandian rivers, since these appear to be its major source of species. The Green, Kahawha, and Monongahela and Allegheny rivers then follow as the most likely refugia of some of the oldest parts of the Ohioan fauna. These are followed by other possible refugia, and then by the Scioto and Muskingum rivers which, after the Wabash, are among the major tributaries of the Ohio on its north side. As mentioned elsewhere, there is no list of the Miami River Unionidae. This river, between the Wabash and Scioto, probably has a fauna similar to that of the Scioto and Muskingum rivers.

A. Of the 74 species found in the Mississippian and Ohioan regions, with the exception of *Lampsilis radiata siliquoidea*, which is unexplainably missing from both the Tennessee and Cumberland rivers, 40 species are sufficiently ubiquitous on both sides of the Ozark Plateau, and on the Cumberland Plateau, to indicate that they may have spread into the Mississippian and Ohioan regions from either or both areas.

B. Eleven species found in both the Mississippian and Ohioan regions, mostly missing in the Tennessee and Cumberland river systems, appear to have reached the Ohioan Region from the west. Seven of these species appear to have had a refugium in the Meramec River or to have come from the Ozarkian Region south of the Ozark Crest, or from even farther south.

With the exception of *Margaritifera falcata*, of the Pacific Coastal Region, which is limited in the Mississippian Region to tributaries of the upper Missouri River in Montana, all of the species from the west are also found in the Ohioan Region. As noted by H. and A. van der Schalie (1950: 456) certain species do not usually inhabit the large rivers, but are found in smaller streams, sloughs, or lakes. Among these species are *Villosa lienosa, Anodonta suborbiculata, A. corpulenta, Ligumia subrostrata,* and *Uniomerus tetralasmus. Anodonta suborbiculata* is monographed as a representative of this group of species. *Lampsilis higginsi, Proptera capax,* and *Arcidens confragosus* are also monographed to illustrate the Ohioan penetration by several other species from the Mississippian Region.

C. The Ohioan Region has 21 species which had refugia in at least the Tennessee and Cumberland or Monongahela and Allegheny rivers. An additional species, *Elliptio complanata* from the Northern Atlantic Slope, reached the Ohioan Region by way of the St. Lawrence River system.

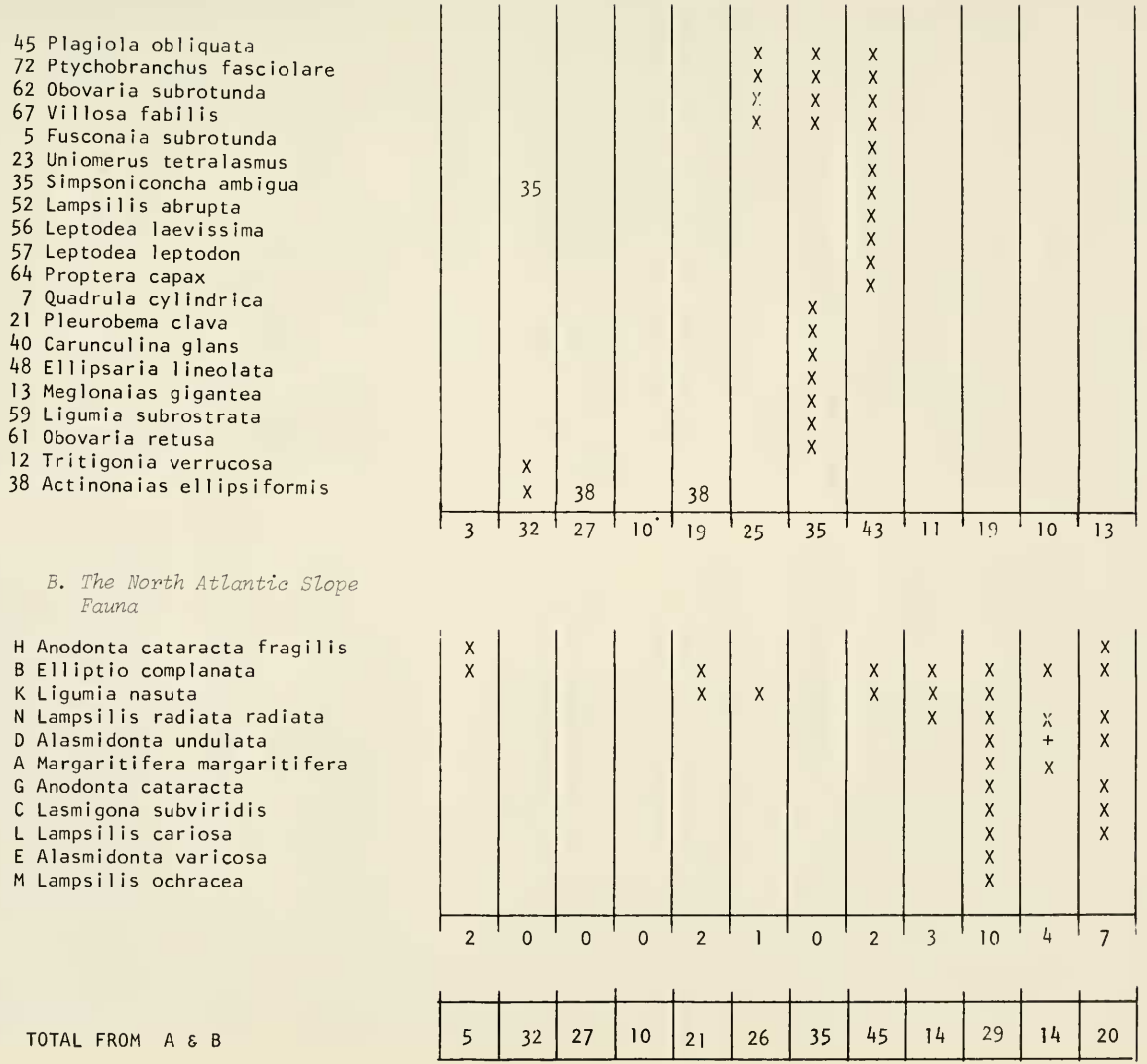
Only two, possibly three, of these 22 species are found in the Mississippian Region, although a number of them are found in the St. Lawrence River system. Two of these Ohioan species: *Quadrula cylindrica* and *Carunculina glans* occur in the Ozarkian Region, south of the Ozark Crest, but are entirely missing north of it. A Cumberlandian species,

TABLE 3

DISTRIBUTION OF UNIONACEA IN THE ST. LAWRENCE RIVER SYSTEM

	Lake Superior	Eastern Wisconsin Rivers	Western Michigan Rivers	Lake Michigan	Lake Huron	Lake St. Clair	Maumee River	Lake Erie	Lake Ontario	Finger Lakes Basin	Lake Champlain	Ontario River
A. The Mississippian, Cumberlandian and Ohioan Faunas												
54 Lampsilis radiata siliquoidea	x	x	x	x	x	x	x	x	x	x	x	x
26 Anodonta grandis	x	x	x	x	x	x	x	x	x	x	x	
32 Lasmigona complanata	x	x	x		x	x	x	x				x
53 Lampsilis ovata		x	x	x	x	x	x	x		x		x
30 Anodontoides ferussacianus		x	x	x	x	x	x	x	x	x	x	x
63 Proptera alata		x	x	x	x	x	x	x	x	x	x	x
58 Ligumia recta		x	x	x	x	x	x	x	x	x	x	x
16 Elliptio dilatata		x	x	x		x	x	x	x	x	x	x
55 Leptodea fragilis		x	x			x	x	x	x	x	x	x
25 Alasmidonta marginata		x	x		x		x	x		x	x	x
36 Strophitus undulatus		x	x		x		x	x		x	x	x
14 Cyclonaias tuberculata		x	x			x	x	x		x	x	
34 Lasmigona costata		x	x		x	x	x	x		x	x	x
2 Amblema plicata		x	x		x	x	x	x	x	x	x	x
68 Villosa iris		x	x		x			x		x		
4 Fusconaia flava		x	x		x		x	x	x	x		
37 Actinonaias ligamentina		x	x			x	x	x	x	x		
28 Anodonta imbecillis		x	x	x	x			x		x		
39 Carunculina parva		x		x			x	x		x		
41 Plagiola triquetra		x	x	x		x		x				
65 Truncilla truncata		x	x	41		x		x				
22 Pleurobema cordatum		x	x		x	x	x	x				
10 Quadrula pustulosa		x	x				x	x				
71 Obliquaria reflexa		x	x			x		x				
6 Fusconaia undata		x						x				
24 Alasmidonta calceolus		x	x	x	x	x	x	x	x	x		
11 Quadrula quadrula		x	x					x				
66 Truncilla donaciformis			x			x		x				
42 Plagiola toruiosa				42		x		x				
50 Lampsilis fasciola				x			x	x				
33 Lasmigona compressa		x			x	x	x	x		x	x	x
60 Obovaria olivaria		x	x		x	x	x	x		x		x

TABLE 3. Continued



Lampsilis abrupta, which also occurs in the Ohioan and Mississippian regions, is monographed.

DISTRIBUTION OF UNIONACEA IN THE ST. LAWRENCE RIVER SYSTEM [Table 3]

A. Fifty-two of the species in the St. Lawrence River system entered there from the Mississippian, Cumberlandian, and Ohioan regions.

B. Eleven species entered the St. Lawrence River system from the Northern Atlantic Slope Region.

DISTRIBUTION OF UNIONIDAE IN THE CANADIAN INTERIOR BASIN [Table 4]

Thirteen of the species found in the Hudson Bay drainage are Mississippian in origin, having entered that region from a former confluence of the Minnesota River, the upper Mississippi River and the Red River. *Lasmigona compressa*, *Lampsilis radiata siliquoidea*, and *Anodontoides ferussacianus* appear to have also invaded the Hudson Bay drainage by way of the St. Lawrence River system. *Elliptio complanata* entered only by way of the latter system. *Anodonta kennerlyi* is derived from the Pacific Coastal region. *Anodonta grandis simpsoniana* appears to be speciating within the Canadian Interior Basin. Only three unionids occur in the Arctic drainage.

DISTRIBUTION OF UNIONACEA IN THE OZARKIAN REGION [Table 5]

Fifty-three of the 74 species found in the Mississippian and Ohioan regions occur below the Ozark Crest (Plate 1, 1), and have the same arabic numerals as those in List 1. An arabic numeral in the body of the table indicates that there are additional data of general interest in the list, while one at the end of a line indicates additional data specifically on the Ozarkian Region. The uniquely Ozarkian unionacean fauna, as well as those species also found in the Gulf Coastal Region are represented by Roman numerals (List 2).

The Ozarkian rivers below the Ozark Crest are arranged on the Table from south to north, while those above the Crest are listed from east to west.

A. With the exception of *Lampsilis radiata siliquoidea*, which is missing from the Tennessee and Cumberland rivers, 40 species are found on the Ozark Plateau, above the Ozark Crest, and on the Cumberland Plateau.

B. Nine species found in the Gulf Coastal and Ozarkian regions, have extended their range into the Mississippian and Ohioan regions.

C. Nine species appear to be of southern origin.

D. Four species afford evidence of the uniformity of the fauna of the Ozarkian and Cumberland plateaus before the formation of the Mississippi River. *Quadrula cylindrica* and *Carunculina glans* are also found in the Ohioan Region, but not in the Mississippian Region.

E. With the exception of *Lampsilis higginsi* and *Proptera capax*, two Ozarkian species which have spread into the Mississippian and Ohioan regions, 8 species are unique to the Ozarkian Region.

SYSTEMATIC SECTION

Selection of the Monographed Species. Fourteen species are monographed. Eight of these are found only in the Ozarkian Region. Six others were selected to illustrate certain distributional pecularities previously discussed. The detailed distribution of the species, based on the published record, and an examination of the specimens in the major collections, is reported for the first time. Among the additional six species, are two other Ozarkian species which extended their ranges in post-glacial time, *Lampsilis higginsi* and *Proptera capax*. *Lampsilis higginsi* and *abrupta*, a closely related Cumberlandian species, are compared. They illustrate overlapping distribution in the

TABLE 4

DISTRIBUTION OF THE UNIONIDAE IN THE CANADIAN INTERIOR BASIN

		ARCTIC DRAINAGE	HUDSON BAY DRAINAGE		
		all rivers	western rivers	Red River	eastern rivers
4	Fusconaia flava (Rafinesque)			X	
11	Quadrula quadrula (Rafinesque)			X	
2	Amblema plicata (Rafinesque)			X	
34	Lasmigona costata (Rafinesque)			X	
36	Strophitus undulatus (Say)			X	
63	Proptera alata (Say)			X	
58	Ligumia recta (Lamarck)			X	
53	Lampsilis ovata (Say)			X	
26	Anodonta grandis grandis Say		X	X	X
33	Lasmigona compressa (Lea)		X	X	X
	Anodonta grandis simpsoniana Lea	X	X	X	X
54	Lampsilis radiata siliquoidea (Barnes)	X	X	X	X
32	Lasmigona complanata (Barnes)		X	X	
30	Anodontoides ferussacianus (Lea)			X	X
B	Elliptio complanata (Lightfoot)				X
f.	Anodonta kennerlyi Lea	X	X		
		3	6	14	6

Mississippian and Ohioan regions. Their specific status, nomenclature, and distribution have been matters of some dispute which are resolved here. *Cyprogenia stegaria*, a Cumberlandian species which extended its range into the Ohioan Region, is compared with *C. aberti*, an Ozarkian species. *Arcidens confragosus* and *Anodonta suborbiculata* are included as examples of species which entered the Ohioan Region from the west in postglacial time, that are widely distributed in the Gulf Coastal Region. *A. suborbiculata* was chosen to show the distribution of that group of species which do not usually inhabit the large rivers, but are usually found in smaller streams, sloughs, or lakes. Among these are also *Villosa lienosa*, *Anodonta corpulenta*, *Ligumia subrostrata* and *Uniomerus tetralasmus*.

Acknowledgements. Thanks are extended to Drs. Joseph Rosewater and Arthur H. Clarke, of the National Museum of Natural History, for allowing me access to the collection under their care and for photographs of types. Dr. George M. Davis, of the Academy of Natural Sciences of Philadelphia, and Dr. Juan J. Parodiz, of the Carnegie Museum, Pittsburgh, kindly made the collections in their charge available for study as did Dr. John B. Burch, of the Museum of Zoology, University of Michigan, Ann Arbor. Dr. Alex S. Tompa, also of the latter institution, kindly arranged for the loan of material. Dr. H. W. Charnley, Jr., of the Buffalo Museum of Science, made two critical lots of *L. capax* available, and Mr. Don Manning, McKenzie, Tennessee, kindly loaned material. Thanks are also

TABLE 5

DISTRIBUTION OF UNIONACEA IN THE OZARKIAN REGION

A. Unionacea common to both the Ozarkian and Cumberlandian Regions.

		OZARKIAN REGION									
		below Ozark Crest					above Ozark Crest				
		Red River System	Black River System	Neosho River *	White River	Black River **	St. Francis River	Meramec River	Gasconade River	Osage River	See list 1
2	Amblema plicata	X	X	X	X	X	X	X	X	X	(2)
12	Tritigonia verrucosa	X	X	X	X	X	X	X	X	X	
16	Elliptio dilatata	X	X	X	X	X	X	X	X	X	
53	Lampsilis ovata	X	X	X	X	X	X	X	X	X	
36	Strophitus undulatus	X	X	X	X	X	X	X	X	X	
71	Obliquaria reflexa	X	X	X	X	X	X	X	X	X	
65	Truncilla truncata	X	+	X	X	+	+	X	X	X	
49	Lampsilis teres	X	X	X	X	+	X	X	X	X	
55	Leptodea fragilis	X	X	X	X	+	+	X	X	X	(55)
10	Quadrula pustulosa	X	X	X	X	+	+	X	X	X	
4	Fusconaia flava	X	X	X	X	X	X	X	X	X	
11	Quadrula quadrula	X	X	X	X	+	+	X		X	
28	Anodonta imbecillis	X	X	X	+	+	+	X		X	
25	Alasmidonta marginata		X	X	+	X	X	X	+	X	
37	Actinonaias ligamentina		X	X	X	X	X	X	X	X	(37)
58	Ligumia recta		X	X	X	X	X	X	X	X	
34	Lasmigona costata		X	X	X	X	X	X	+	X	
22	Pleurobema cordatum		X	X	X	X	X	X	X	X	
3	Fusconaia ebena		+	+	X	+	+	X		X	
8	Quadrula metanerva		X	X	X	X	+	X			
14	Cyclonaias tuberculata	X		X	X	X	X	X	+	X	
54	Lampsilis radiata siliquoidea			X	X	X	X	X	X	X	
24	Alasmidonta calceolus			X	X	X	X	X	X		
48	Ellipsaria lineolata		X	X	X	+		X	X	X	
57	Leptodea leptodon		X		X	+		X	X		
60	Obovaria olivaria				X	+	+	X		X	
68	Villosa iris				X	X		X			
39	Carunculina parva	X	X	X	X		X	X		X	
15	Elliptio crassidens crassidens		+		X			X	X		
26	Anodonta grandis grandis	X	X	X	X		+	X	X	X	
66	Truncilla donaciformis	X	X	X		+	+	X	X	X	
32	Lasmigonia complanata	X	X	X		+	+	X		X	(32)
41	Plagiola triquetra					41		X			
56	Leptodea laevissima	X		X		+	+	X	X	X	
13	Megalonaias gigantea	X		X			+	X	X	X	
63	Proptera alata			X				X	X	X	(63)
19	Plethobasus cyphyus			X				X	X		(19)
1	Cumberlandia monodonta		X					X	X	X	(1)
30	Anodondoites ferussacianus				X		X	X			(30)
35	Simpsoniconcha ambigua				X			X			(35)
		20	28	32	32	31	31	40	29	31	

extended to my colleagues, Dr. Kenneth J. Boss who read the manuscript; and to Dr. Ruth D. Turner who thankfully read the manuscript with a very critical eye. Dr. Arthur H. Clarke of the National Museum of Natural History kindly read the manuscript and made a number of significant suggestions. Dr. David H. Stansbery, of the Ohio State Museum, helpfully, offered several opinions. Mr. Douglas G. Smith, of the Museum of Zoology, University of Massachusetts, Am-

TABLE 5. Continued

		OZARKIAN REGION									
		below Ozark Crest					above Ozark Crest				
		Red River System	Black River System	Neosho River *	White River	Black River **	St. Francis River	Meramec River	Gasconade River	Osage River	See list 1 or 2
	B. Unionidae common to both the Gulf Coastal and Ozarkian Regions, also found in the Mississippian and Ohioan Regions.										
6	Fusconaia undata	X	X		X	+	X	X	X	X	(6)
31	Arcidens confragrosus	X			X	X	X	X		X	
23	Uniomerus tetralasmus	X	X	X	X		X	X		X	(23)
59	Ligumia subrostrata	X	X	X		+	X	X		X	
38	Actinonaias ellipsiformis			+	X	X		X		X	(38)
9	Quadrula nodulata	X	+	X	X	+	+				
69	Villosa lienosa	X	X		X	X	X				
29	Anodonta suborbiculata	+	X	X		X	X				
27	Anodonta corpulenta	X	+		X		+	X			
		8	7	5	7	7	8	6	1	5	
	C. Unionidae common to both the Gulf Coastal Region and the Ozarkian Region, below the Ozark Crest.										
XIV	Proptera purpurata	X	X	X	+	+	+				
XI	Lampsilis hydiana	X	X		X	+	X				(X)
XIII	Obovaria jacksoniana	X	X		X	+	X				
II	Plectomerus dombeyanus	X	X		X	+	+				
X	Lampsilis satur	X	X		X	X	+				(IX)
XVII	Villosa vibex				X						
III	Quadrula apiculata	X									
VIII	Glebula rotundata	X									
IX	Lampsilis excavata		+								(VIII)
		7	6	1	5	5	5	0	0	0	
	D. Unionidae common to both the Ozarkian Region, below the Ozark Crest, and the Cumberlandian Region.										
7	Quadrula cylindrica		X	X	X	X	X				
40	Carunculina glans		X	+	X						
VI	Plagiola florentina				X	X					
VII	Plagiola turgidula				X	X					
		0	2	2	4	3	1	0	0	0	
	E. The Ozarkian Fauna										
XIX	Ptychobranchus occidentalis	X	X	X	X	X	X	X			
XVIII	Cyprogenia aberti		X	X	X	X	X	X			
51	Lampsilis higginsi		X		X	X		X	X		(51)
XII	Lampsilis powelli		X	X	X						
I	Fusconaia ozarkensis			X	X	X	X		X		
V	Actinonaias rafinesqueana			X	X	X					
XVI	Villosa reeviana				X	X		X	X	X	
64	Proptera capax				X		X				
IV	Arkansia wheeleri	X	X								
XV	Villosa arkansasensis		X								
		2	6	5	8	5	4	4	3	1	
	Total A-E	37	49	45	56	51	49	50	33	37	

* Arkansas River System
All the species are found in the Neosho River drainage.

** White River System

** Total 63

herst, supplied certain data on the Lake Champlain fauna. Most of the photographs were taken by Mr. David L. MacHenry. The maps and tables were carefully prepared by Miss Catharine G. Kessler who also helped with other numerous details, including proofreading.

At my last moment request, Steven Ahlstedt, Tennessee Valley Authority; Alan C. Buchanan, Missouri Department of Conservation; Mark E. Gordon; University of Arkansas; and R. D. Oesch, Glendale, Missouri; all kindly supplied me with data and specimens.

Pattern Used in Descriptions.

Abbreviations. The following abbreviations have been used in the text and on the plate captions:

ANSP	Academy of Natural Sciences of Philadelphia, Pennsylvania
CM	Carnegie Museum, Pittsburgh, Pennsylvania
MCZ	Museum of Comparative Zoology, Cambridge, Massachusetts
MZUM	Museum of Zoology, University of Michigan, Ann Arbor, Michigan
OSM	Ohio State Museum, Columbus, Ohio
USNM	National Museum of Natural History, Washington, D. C.

Synonymy. For ease of reference, full citations are included for each taxon, including the type locality and the location of the type when known. References to plates and figures are not included under Lea's *Observations on the Genus Unio* since they are always the same as in the preceding entry. In some instances, lectotypes are selected. Elsewhere in the text, references are abbreviated and require the use of the bibliography. Except for the original references, only relevant citations since 1914 are included here since earlier ones are available in Simpson (1914).

Descriptions. The measurements are only intended to convey the general size of specimens from a given station, and to indicate sexual differences.

Anatomy and Breeding Season. The available data are cited.

Habitat. Included when known.

Remarks. These are designed to elucidate the differences between the sexes and the species, and include comments on distribution and taxonomy.

Range. The distribution is summarized.

Abundance. The former abundance of the species is based on the number and size of the lots found in the several collections studied. Their present abundance is based on the opinions of Stansbery (1970, 1971, 1976).

Specimens Examined. Most of the records are based on the specimens in the collections mentioned above. These collections contain most of the specimens available for study. With the exception of those in the Ohio State Museum, most of those in the other institutions have been personally examined. The records are followed by the initials of the institution in which they were observed. In most instances when records were duplicated only references to the specimens in the Museum of Comparative Zoology were included, though in certain critical cases several references are mentioned. Specimens not seen are credited to the responsible individual or published reference and to the associated institution, if it is known. The published references may be found either under *Synonymy* or under *Literature Cited*, or sometimes under both headings.

Distribution. The various river systems are listed from west to east. East of the Mississippi River this arrangement approximates the direction of post-glacial dispersal.

Arrangement of the Records. The river systems of the Gulf Coastal Region are listed from west to east. The drainages below the Ozark Crest are listed from south to north. In the Ozarkian Region, above the Crest, the rivers flowing into the Missouri from the south are listed from west to east. The records for all of the above mentioned rivers are arranged

from the headwaters to the mouth. Above the Missouri River the Mississippian drainages are listed from south to north and the records are arranged from mouth to headwaters, approximating the direction of post-glacial dispersal. In the Cumberlandian and Ohioan regions the rivers flowing into the Ohio are listed from west to east. The records of those on the south side of the Ohio River are arranged from headwaters to mouth, while those of the Ohio itself and the tributaries above it are arranged from mouth to headwaters, approximating the direction of post-glacial dispersal.

The cumbersome term, Mobile-Alabama-Coosa river system, is used because it reflects the main channel of the river, which was given a different name at each important confluence.

Figures. When available, holotypes, allotypes and lectotypes are generally used to illustrate each species. Some of the data on the plate captions, such as the measurements, are not repeated elsewhere.

The distributional maps are based on Rand McNally and Company's *Commercial Atlas of America* 1912 Edition, plate 21, which indicates United States Inland Waterways.

Superfamily **UNIONACEA** Thiele 1935
Family UNIONIDAE (Fleming 1828) Ortmann 1911
Subfamily AMBLEMINAE
Tribe AMBLEMINI
Genus *Fusconaia* Simpson

Fusconaia Simpson 1900, Proc. U. S. Natl. Mus. **22:** 784. Type species, *Unio trigonus* Lea, original designation.

Fusconaia ozarkensis (Call)
Plate 9, figures 1–4
Distribution: Plate 8 A

Unio ozarkensis Call 1887, Proc. U. S. Natl. Mus. **10:** 498, pl. 27 (Currant [Current] River, Shannon Co., Missouri, and in Jacks Fork and Big Creek, tributaries to it; lectotype MCZ 5707 selected by Johnson, 1975, Occ. Papers on Moll. **4:** 143, specimen portrayed in figs. 1–3; figured paralectotype MCZ 5705; *both* from Jacks Fork [Shannon Co.]).

Pleurobema brevis subelliptica Simpson 1900, Proc. Acad. Nat. Sci. Phila. **52:** 80 (Spring River, Hardy [Fulton Co.], Arkansas; lectotype USNM 159952 selected by Johnson, 1975, Special Occ. Pub. no. 4, Dept. Moll., Mus. Comp. Zool., p. 20, pl. 2, fig. 7).

Pleurobema pannosa Simpson 1900, Proc. Acad. Nat. Sci. Phila. **52:** 82 (White River; [Ouachita River], Hot Springs, [Garland Co.]; *both* Arkansas); 1900, Proc. U. S. Natl. Mus. **22:** 799. The measured type, from the latter locality, was not located by Johnson (1975a: 16). Included in this synonymy on the authority of Ortmann (1917, Nautilus **31:** 62).

Pleurobema utterbackii Frierson 1915 [in] Utterback, Amer. Midl. Nat. **4:** 197 [86], pl. 5, figs. 12 a, b; pl. 20, figs. 63 A–D (White River, Hollister, [Taney Co.], Missouri; holotype MCZ 271448, refigured by Johnson, 1972, Occ. Papers on Moll. **3:** 151, pl. 24, fig. 5).

Quadrula flava sampsoniana Frierson 1927, Check list N. American naiades, p. 55 (Elk River, [McDonald Co.], Missouri; holotype MZUM 92226, refigured by Johnson, 1972, Occ. Papers on Moll. **3:** 149, pl. 25, fig. 5).

Fusconaia ozarkensis (Call). Ortmann, 1917, Nautilus **31:** 62.

Description. Shell medium in size, seldom exceeding 70 mm in length. Outline elliptical to subtrapezoid. Valves usually somewhat compressed, solid, inequilateral. Anterior end regularly rounded. Posterior end slightly biangulate below the medial line. Ventral margin straight or regularly curved. Dorsal margin straight forming an indistinct angle with the obliquely descending posterior margin. Hinge ligament long. Posterior ridge double, but very faint. Umbos small and low, not much projected above the hinge line, their sculpture consisting of several coarse undulations. Surface of the shell rather smooth, rest stops usually clearly marked. Periostracum yellowish-brown or olivaceous, often marked with numerous obscure narrow green rays, arranged on the central portion of the disk.

Left valve with two triangular pseudocardinal teeth of about equal height, two curved lateral ones. Right valve with one high, triangular pseudocardinal, a smaller one before and behind it, and one strong lateral tooth. Anterior and poste-

rior muscle scars, and pallial line all well impressed. Nacre usually white or bluish, iridescent posteriorly.

Length mm	Height mm	Width mm	
68	42	26	White River, Hollister, Taney Co., Missouri. Holo of *P. utterbackii*.
59	38	20	Big Fork, Texas Co., Missouri.
55	36	20	Jacks Fork, Shannon Co., Missouri. Lectotype of *U. ozarkensis*.

Anatomy and Breeding Season. The anatomy was discussed by Ortmann (1917: 63), and on the basis of it, he recognized that *ozarkensis* was a *Fusconaia*. He further noted that the glochidia are subelliptical, slightly higher than long; 0.15 × 0.18, and that the species is tachytictic.

Habitat. Found by Call in shallow mountain streams, "being swift, and limpid, with rocky bottoms."

Remarks. Fusconaia ozarkensis (Call) does not much resemble any other Ozarkian species. It is, however, very close to *Fusconaia barnsiana* (Lea) of the Cumberlandian Region. *F. ozarkensis* has a more elongated, subtrapezoidal shell, more anterior umbos, and the rays on the disk are faint, at best, and generally entirely wanting, where those of *barnsiana* are well developed.

Ortmann (1917: 63) indicated that the syntype, subsequently selected as the lectotype, is less typical of the general shape of the shell than is that of the figured paralectotype, and that the difference in shell morphology is not a sexual one as it was thought to be by Call.

Range. Found only in the Ozarkian Region: below the Ozark Crest in the Black, Arkansas, White, and St. Francis river systems; and above it in the Gasconade River system.

Abundance. Apparently not taken in large numbers, except in the Current River drainage of the White River system and in the Big Piney River of the Gasconade River system.

Specimens Examined

Black River System

Ouachita River Drainage. *Arkansas:* [Ouachita River] Hot Springs, Garland Co. (Simpson).

Arkansas River System

Neosho River Drainage. *Missouri:* Neosho River (Utterback, 1917, Table [as *utterbackii*]); Elk River, McDonald Co. (MZUM).

White River System

White River Drainage. *Missouri:* James River, Galena, Stone Co.; White River, Hollister, Taney Co. (*both* MCZ). *Arkansas:* White River, Cotter (MZUM), and Norfolk (CM), *both* Baxter Co.; Big Buffalo Fork of White River, below Gilbert, Searcy Co. (Meek and Clark, 1912: 10).

Current River Drainage. *Missouri:* Big Creek, Texas Co.; Jacks Fork; Current River, 5.8 mi. NE Eminence; *both* Shannon Co.; Current River 1 mi. SW Doniphan, Ripley Co. (*all* MCZ).

Spring River Drainage. *Arkansas:* Spring River, Hardy, Fulton Co. (MCZ).

St. Francis River System

St. Francis River Drainage. *Missouri:* St. Francis River (Utterback, 1917, Table [as *utterbackii*]).

Gasconade River System

Gasconade River Drainage. *Missouri:* Big Piney River, 10 mi. W Licking, Texas Co.; Gasconade River, 6 mi. NW Vichy, Maries Co. (*both* MCZ).

Subfamily UNIONINAE
Tribe ANODONTINI
Genus *Anodonta* Lamarck

Anodonta Lamarck 1799, Memoires de la Soc. d'Hist. Nat. de Paris, p. 87. Type species, *Mytilus cygneus* Linnaeus. Monotypic. Placed on the Official List of Generic Names in Zoology, in 1926, Opinion 94. Reconfirmed, 1959, Opinions and Declarations rendered by Int. Comm. Zool. Nomen., **20** (28): 303–310, Opinion 561.

Subgenus *Utterbackia* F. C. Baker

Utterbackia F. C. Baker 1927, Amer. Midl. Nat. **10:** 221, 222 (misspelled as *Utterbachia* on p. 221). Type species, *Anodonta imbecillis* Say, original designation.

Utterbackiana Frierson 1927, Check list N American naiades, p. 17. Type species, *Anodonta suborbiculata* Say, monotypic. Discussed by Johnson, 1970, Bull. Mus. Comp. Zool. **140:** 362.

Nayadina Haas 1969, Das Tierreich, pt. 88, p. 359, *non* Gregorio 1914. Walker (1918: 176) correctly pointed out that the type species of *Nayadina*, *Anodonta venusta* Gregorio is a synonym of *Anodonta grandis* Say.

Anodonta (*Utterbackia*) *suborbiculata* Say

Plate 9, figure 5
Distribution: Plate 5

Anodonta suborbiculata Say 1831 [Jan. 29] New Harmony [Indiana] Disseminator [no pagination] (Ponds near the Wabash [River, near New Harmony, Posey Co., Indiana], type ANSP [lost], *teste* Johnson and Baker, 1973, Proc. Acad. Nat. Sci. Phila. **125:** 146). Say, 1831, American Conch. no. 2 [letter press], pl. 11. Simpson, 1914, Cat. Naiades **1:** 400. Parmalee, 1967, Illinois State Mus. Pop. Sci. Ser. **8:** 48, pl. 15 B. Starrett, 1971, Illinois Nat. Hist. Surv. Bull. **30:** 320, pl. 3, fig. 19.

Anodonta (*Utterbackiana*) *suborbiculata* Say. Frierson, 1927, Check list N American naiades, p. 17.

Anodonta (*Nayadina*) *suborbiculata* Say. Haas, 1969, Das Tierreich, pt. 88, p. 360.

Description. Shell medium to large, reaching over 130 mm in length. Outline suborbiculate. Valves subinflated, thin but strong, gaping in front and behind. Anterior end regularly rounded, posterior end broadly pointed at about the medial line. Ventral margin regularly curved. Dorsal margin straight, ending in a wing like angle before and behind. Posterior slope slightly incurved above the low posterior ridge. Umbos very low and compressed in young specimens, becoming somewhat fuller in adults, but not much if at all; raised above the hinge line, umbonal sculpture consisting of a few irregular, feeble undulations, each of which has on it, small sharp, tubercles which form two imperfectly radiating rows, located somewhat anterior of the center. Periostracum smooth and shining in young shells, pale yellow green, with numerous very fine green rays. Older shells are concentrically sculptured and the periostracum is smokey or yellowish and often nearly rayless.

Hinge without any trace of denture. Umbonal cavities shallow. Muscle scars indistinct. Nacre silvery and iridescent, sometimes tinted bluish or purplish.

Length mm	Height mm	Width mm	
170	126	58	Keokuk Lake, Muscatine, Muscatine Co., Iowa.
130	100	43	Spoon River, Illinois.

Anatomy and Breeding Season. The anatomy and breeding season of *A. suborbiculata* are not known. Sexuality and other aspects of reproduction of all the other members of the subgenus *Utterbackia* are discussed by Heard (1975). A glochidium was figured by Surber (1915: 4, pl. 1, fig. 1).

Habitat. Found in a sand or mud bottom, in water with an average depth of five to eight feet, usually in lakes or sloughs where the current is not strong.

Remarks. Anodonta suborbiculata Say is very easily identified. Since the hinge teeth are completely absent it is easily recognized as an *Anodonta*, and as the umbos are flat, and not raised above the hinge line it may be recognized as belonging to the subgenus *Utterbackia.* Its orbiculate outline separates it from the other members of the subgenus.

The records of *A. suborbiculata* from Nebraska (Aughey, 1877) have never been verified. This species was not found in the Tennessee River system by Ortmann (1918, 1924, 1925) which suggests that its occurrence behind the Wheeler Dam may be the result of the subsequent introduction of fishes. In any event, the dam created an environment the species prefers.

Range. Gulf Coastal Region: Trinity River system, Texas and the Escambia River system, Florida. Lower Mississippi River drainages. Ozarkian Region: Red

and Black river systems, Arkansas; Arkansas River system, Kansas; White and St. Francis river systems, Missouri and Arkansas; all below the Ozark Crest; above it, the Meramec River system, Missouri. Mississippian Region: Missouri and Illinois rivers; Mississippi River and drainages from Illinois north to Wisconsin. Cumberlandian Region: Tennessee River, Alabama. Ohioan Region: Wabash River drainage, Indiana; Green River, Kentucky.

Abundance. This species appears to be rare, though occasionally very abundant locally. Taken in great numbers by Strode (1891) in Thompson's Lake, Illinois.

Specimens Examined

Gulf Coastal Region

Trinity River System

Trinity River Drainage. *Texas:* Wards Prairie Lake, nr. Romayor, Liberty Co. (MCZ).

Escambia River System

Escambia River Drainage. *Alabama:* Escambia River, nr. Pollard, Escambia Co. (MZUM). *Florida:* Chumucklee Spring Lake, nr. McDavid, Escambia Co. (MZUM).

Conecuh River Drainage. *Alabama:* Gantt Lake, Clearview, Covington Co. (MCZ).

Ozarkian Region

Red River System

Red River Drainage. *Arkansas:* Little River (MZUM). Mercer Bayou, N Black Diamond, Miller Co. (MCZ). *Louisiana:* Red River (MZUM); Frierson (USNM); Clear Lake; Edwards Lake (*both* MZUM); *all* De Soto Parish. Black Lake Bayou, Lebanon, Bienville Parish. [Red River] Alexandria, Rapides Parish (USNM).

Black River System

Ouachita River Drainage. *Arkansas:* Old River, Arkadelphia, Clarke Co. (Wheeler, 1918: 121).

Arkansas River System

Neosho River Drainage. *Kansas:* Neosho River, Woodson Co. (Call, 1885b: 96); pond E Neosho River, 4.5 mi S Humboldt, Allen Co. (Murray and Leonard, 1962: 160).

White River System

Black River Drainage. *Missouri:* Black River, Hendrickson, Butler Co. (MCZ). *Arkansas:* Black River, Black Rock (MCZ); Spring River, Black Rock (MZUM); *both* Lawrence Co.

St. Francis River System

Tyronza River Drainage. *Arkansas:* Pond, nr. Tyronza River, Tyronza, Poinsett Co. (MZUM).

Meramec River System

Meramec River Drainage. *Missouri:* Creve Coeur Lake, St. Louis Co. (MCZ).

Mississippi River System

Mississippi River Drainage. *Tennessee:* Mississippi River, Presidents Island, nr. Memphis, Shelby Co. (MCZ).

Mississippian Region

Missouri River System

Elkhorn River Drainage. *Nebraska:* Elkhorn River (Aughey 1877: 704).

Missouri River Drainage. *Missouri:* Lake Contrary, St. Joseph, Buchanan Co. (MZUM).

Kansas River Drainage. *Nebraska:* Big Blue River (Aughey 1877: 704).

Mississippi River System

Mississippi River Drainage. *Illinois:* Mississippi River, Alton, Madison Co. (MCZ).

Sangamon River Drainage. *Illinois:* Clear Lake nr. Springfield, Sangamon Co. (MCZ).

Spoon River Drainage. *Illinois:* Spoon River; Simpsons Lake; Thompsons Lake; (*all* MCZ) *all* Fulton Co.

Illinois River Drainage. *Illinois:* Illinois River, Mossville, Peoria Co. (Starrett, 1971: 320).

Kaskaskia River Drainage. *Illinois:* Kaskaskia River (Parmalee, 1967: 48).

Mississippi River Drainage. *Iowa:* Keokuk Lake, Muscatine, Muscatine Co. (MCZ). *Wisconsin:* Mississippi River, La Crosse, La Crosse Co. (Mathiak, 1979: 7).

Cumberlandian Region

Tennessee River System

Tennessee River Drainage. *Alabama:* Tennessee River, Wheeler Reservoir [Lawrence Co.] (MZUM).

Ohioan Region

Ohio River System

Wabash River Drainage. *Indiana:* Ponds nr. the Wabash River, New Harmony, Posey Co. (Say); Wabash River (Call, 1900: 533).

Green River Drainage. *Kentucky:* Barren River; Pond nr. Bowling Green, Warren Co. (*both* MZUM).

Genus *Arcidens* Simpson

Arcidens Simpson 1900, Proc. United States Natl. Mus. **22:** 661. Type species, *Alasmodonta confragosa* Say, original designation. This genus is monotypic.

Arcidens confragosus (Say)

Plate 10, figures 1, 2

Distribution: Plate 4

Alasmodonta confragosa Say 1829, New Harmony [Indiana] Disseminator **2** (22): 339 (Fox River, of the [Little] Wabash [River, Richland Co., Illinois], type ANSP [lost], *teste* Johnson and Baker, 1973, Proc. Acad. Nat. Sci. Phila. **125:** 146); 1831, American Conch. no. 3 [letter press], pl. 21; 1832, no. 4, p. [4] of wrapper.

Arcidens confragosa jacintoensis Strecker 1931, Baylor Univ. Mus. [Waco, Texas], Spec. Pub. 2, p. 13 (San Jacinto River, Liberty Co., Texas; syntypes presumed to be in the Strecker Museum [not available]; topotype MCZ 23317).

Arcidens confragosus (Say). Simpson, 1914, Cat. Naiades, **1:** 475. Utterback, 1915, Amer. Midl. Nat. **4:** 254 [103], pl. 22, figs. 72 A and B. Coker, 1919, Bull. U. S. Bur. Fisheries for 1917–18, **36:** 34, pl. 21, lower pair. Frierson, 1927, Check list N American naiades, p. 21. Baker, 1928, Wisconsin Geol. and Nat. Hist. Surv. Bull. **70** (2): 196, pl. 63, figs. 4–7. Murray and Leonard, 1962, Univ. Kansas, Mus. Nat. Hist. Misc. Pub. **28:** 97. Parmalee, 1967, Illinois State Mus. Pop. Sci. Ser. **8:** 51, pls. 16 A; 33 A. La Rocque, 1967, Ohio Geol. Surv. Bull. no. 62 (2): 208, fig. 94; fig. 95 distributional map. Haas, 1969, Das Tierreich, pt. 88, p. 396. Starrett, 1971, Illinois Nat. Hist. Surv. Bull. **30:** 312, pl. 3, fig. 13.

Description. Shell medium to large, often exceeding 100 mm in length. Outline rhomboid. Valves inflated, subsolid, or solid, slightly inequilateral. Anterior end regularly rounded. Posterior end somewhat produced below the medial line. Ventral margin regularly curved. Dorsal margin straight, forming a sharp wing like angle with the very straight, obliquely descending posterior margin. Hinge ligament long. Posterior ridge rather high, but indistinct. Posterior slope with numerous heavy, radial corrugations. Umbos high and full, much projected above the hinge line, their sculpture consisting of irregular, doubly-looped ridges, the bases of the loops being developed into strong, pinched-up nodules, which extend out on to the disk of the shell; in front of, and behind, the loops there are a number of radiating, wavy, subnodulous lirae or small ridges; from the anterior row of knobs extending backwards and downwards there is a series of strong folds and these are crossed by wrinkled, radiating, sometimes zigzagged threads. The anterior base usually has merely concentric striae. Periostracum subshiny or dull, brownish green, or olive; occasionally quite greenish and banded.

Left valve with an arched, somewhat elongated pseudocardinal tooth under the umbo which curves upward, in front of which, there is a lower compressed

tooth. Right valve with a strong subcompressed tooth in front of the umbo. The hinge plate is cut away from the umbo for the reception of the tooth in the left valve. The lateral teeth reduced to vestigial blurs. Umbonal cavities deep, anterior muscle scars shallow, posterior ones and pallial line quite indistinct. Nacre bluish-white or dull white, with a wide prismatic border.

Length mm	Height mm	Width mm	
115	78	48	Rough River, Dundee, Ohio Co., Kentucky.
105	77	51	Fox River, Illinois. Topotype MCZ 53004.
84	57	32	San Jacinto River, Texas. Topotype MCZ 23317.

Anatomy and Breeding Season. The anatomy was discussed by Ortmann (1912: 284, fig. 12). A glochidium was figured by Surber (1912, pl. 1, fig. 5) 0.355 × 0.350. This species is bradytictic, probably from September to June (Baker, 1928: 197). Host fish not recorded.

Habitat. Found in a sand or mud bottom in sluggish water a few feet deep.

Remarks. Arcidens confragosus (Say), a widely distributed species, is not very closely related to any other unionid, except *Arkansia wheeleri* Ortmann and Walker which is found only in the Ozarkian Region in the upper Red and Black river systems. The sculpture of *Arcidens* is much more complicated than that of *Arkansia* and covers most of the surface of the shell, while that of *Arkansia* is restricted to the posterior half of the disk. The radiating wrinkles and curved folds on the dorsal slope are much alike in both, but the folds on the posterior disk of *Arkansia* more closely resemble those of *Amblema plicata* (Say). The umbonal sculpture of *Arcidens* somewhat resembles that of *Quadrula quadrula* Rafinesque, but *Arcidens* does not much resemble the latter in any other way. While the umbonal sculpture of *Arkansia* is comparatively simple and confined to the upper umbo, that of *Arcidens* is developed into strong pitched up nodules, at the base of the loops, and extends out onto the disk. The lateral teeth in *Arcidens* are not as well developed as those of *Arkansia*, but the presence of the interdental projection in the left valve and the cutting away of the interdentum in the right valve opposite it, relates *Arkansia*, *Arcidens*, and *Lasmigona*.

This species was not found in the Tennessee River by Ortmann (1918, 1924, 1925), which strongly suggests that its present occurrence in Kentucky Lake behind an impoundment on the lower Tennessee River is the result of the recent introduction of fishes.

Range. Gulf Coastal Region: from the Colorado River system, Texas, east to the Tombigbee River drainage of the Mobile-Alabama-Coosa River system, Mississippi. Lower Mississippi River drainages. Ozarkian Region: Red, White and St. Francis river systems below the Ozark Crest; above it the Osage and Meramec river systems. Mississippian Region: Missouri River system; Illinois River; Mississippi River and drainages from Illinois north to Minnesota. Cumberlandian Region: lower Tennessee River, Tennessee. Ohioan Region: Wabash River drainage, Indiana; Green River drainage, Kentucky; Ohio River, east to Cincinnati, Hamilton Co., Ohio.

Reported from the St. Lawrence River System: Great Lakes Drainage (Lake Michigan) *Illinois*: Chicago, Cooke Co. by Baker (1906: 74) as in the State Laboratory, now the Illinois Natural History Survey, Urbana, Illinois. This record could not be verified there (Smith, pers. comm.) or at the Museum of Natural History of the University of Illinois, also at Urbana (Hoffmeister, pers. comm.). It is regarded as an erroneous record, since like other anodontine species *Arcidens* prefers the oozy mud of river margins where there is little current.

Abundance. "The species is rare but widely distributed" (Coker, 1919: 34).

Specimens Examined

Gulf Coastal Region

Colorado River System

Colorado River Drainage. *Texas:* Colorado River, Austin, Travis Co. (Strecker); Skull Creek, Colorado Co. (USNM).

Brazos River System

Brazos River Drainage: *Texas:* West Yegua Creek, Lee Co. (MZUM).

Buffalo Bayou System

Buffalo Bayou Drainage. *Texas:* Buffalo Bayou, near Eureka (MCZ), Houston (USNM); *both* Harris Co.

San Jacinto River System

San Jacinto River Drainage. *Texas:* San Jacinto River, Liberty Co. (MCZ, MZUM).

Trinity River System

Trinity River Drainage. *Texas:* Trinity River, Dallas (MCZ); Elm fork of Trinity River (Strecker); *both* Dallas Co. Trinity River (MZUM); Chambers Creek (Strecker); *both* Navarro Co.

Neches River System

Neches River Drainage. *Texas:* Neches River, Smith Co. (Strecker). Neches River, Big Eddy, Henderson Co. (Strecker). Poe Lake, Nacogdoches Co. (MZUM).

Sabine River System

Sabine River Drainage. *Texas:* Sabine River, Gladewater, Gregg Co. (Strecker). *Louisiana:* Sabine River, Logansport, De Soto Parish (MCZ).

Atchafalaya River System

Atchafalaya River Drainage. *Louisiana:* Bayou Waukasha, 3 mi. S of Lebeau, arm of Atchafalaya River, 10 mi. SE of Lebeau (*both* MCZ); *both* St. Landry Parish. Bayou Teche, St. Mary Parish (USNM).

Lake Maurepas-Pontchartrain-Borgne System

Louisiana: Baton Rouge, East Baton Rouge Parish (MCZ).

Pearl River System

Pearl River Drainage. *Mississippi:* Pearl River, Jackson, Hinds Co. (MCZ, USNM, MZUM).

Pascagoula River System

Chickasawhay River Drainage. [*Mississippi:* Chunkey Creek], Enterprise, [Clarke Co.] (Simpson, 1914: 476, as Enterprise, Alabama).

Mobile-Alabama-Coosa River System

Tombigbee River Drainage. *Mississippi:* Tombigbee River, Columbus, Lowndes Co. (MZUM).

Mobile River Drainage. *Alabama:* Mobile River, 30 mi. N Mobile, Mobile Co. (MCZ).

Lower Mississippi River Drainages

Tensas River System

Tensas River Drainge. *Louisiana:* branch of Tensas River, 15 mi. W Tallulah, Madison Co. (MZUM).

Big Black River System

Big Black River Drainage. *Mississippi:* Big Black River (Hinkley, 1906, Nautilus **20:** 53).

Yazoo River System

Yalabusha River Drainage. *Mississippi:* Yalabusha River, Grenada Co. (MZUM).

Ozarkian Region

Red River System

Red River Drainage. *Arkansas:* Mercer Bayou, N Black Diamond, Miller Co. (MCZ). *Louisiana:* Red River (MZUM) Caddo Lake, Chicot Bayou; Wallace Bayou; (*all* MZUM) *all* Caddo Parish. Frierson (USNM); Bayou Pierre (MZUM; CM); *both* De Soto Parish.

White River System

Black River Drainage. *Missouri:* Black River, Hendrickson, Butler Co. (MCZ).

Cache River Drainage. *Arkansas:* Cache River, Nemo, Craighead Co. (MZUM).

St. Francis River System

St. Francis River drainage. *Arkansas:* St. Francis River, Marked Tree, Poinsett Co. (MZUM).

Meramec River System

Meramec River Drainage. *Missouri:* Meramec River, Crawford Co. (Buchanan); Meramec River, Fern Glen, St. Louis Co. (MZUM).

Bourbeuse River Drainage. *Missouri:* Bourbeuse River, Franklin Co. (Buchanan).

Osage River System

Osage River Drainage. *Kansas:* Marais des Cygnes River, 3 mi. E Ottawa, Franklin Co. (Murray and Leonard). *Missouri:* Marais des Cygnes River, Rich Hill (MZUM), Papinsville (Utterback); *both* Bates Co.; Grand River, Henry Co. (MZUM); Grand River, Warsaw, Benton Co.; Osage River (*both* Utterback).

Mississippian Region

Missouri River System

James River Drainage. *South Dakota:* James River, near Frankfort, Spink Co.; James River, Riverside, Hanson Co. (*both* Coker and Southall).

Missouri River Drainage. *Missouri:* Lake Contrary, St. Joseph, Buchanan Co.; Platte River (*both* Utterback).

Mississippi River System

Big Muddy River Drainage. *Illinois:* Big Muddy River, DeSoto, Jackson Co.; Blairsville, Williamson Co.; Waltonville, Jefferson Co. (*all* Mus. Nat. Hist., Univ. Illinois, pers. comm.).

Kaskaskia River Drainage. *Illinois:* Kaskaskia River, Washington Co. (MCZ).

Mississippi River Drainage. *Illinois:* Mississippi River, Alton, Madison Co. (MCZ).

Illinois River Drainage. *Illinois:* Illinois River, 10 mi. below Hardin, Calhoun Co. (Bartsch; USNM). Illinois River, Meredosia, Morgan Co. (MCZ). Illinois River, Havana, Mason Co. (Parmalee). Illinois River, Peru (MCZ); Utica (Baker); *both* LaSalle Co.

Sangamon River Drainage. *Illinois:* Sangamon River, Springfield, Sangamon Co. (MCZ). Sangamon River, 4 mi. above Mahomet, Champaign Co. (Baker, 1922: 143).

Mississippi River Drainage. *Illinois:* Mississippi River, Quincy, Adams Co. (MCZ). Mississippi River, Warsaw, Hancock Co. (MCZ). *Iowa:* Mississippi River below Burlington, Des Moines Co. (MCZ). *Illinois:* Benton Slough, Henderson Co. (MCZ).

Rock River Drainage. *Illinois:* Pecatonica River (MCZ).

Mississippi River Drainage. *Illinois:* Mississippi River, Moline, Rock Island Co. (MCZ). *Iowa:* Mississippi River, Clinton, Clinton Co. (MCZ). *Wisconsin:* Mississippi River, Prairie du Chien, Crawford Co. (Baker). Mississippi River, Pierce Co. (Grier).

Minnesota River Drainage. *Minnesota:* Minnesota River, 2.8 mi. SW Bloomington, Hennepin Co. (Stansbery, OSM).

Cumberlandian Region

Tennessee River System

Tennessee River Drainage. *Tennessee:* Kentucky Lake (of Tennessee River) 6

mi. above New Johnsonville, Benton Co. (MCZ).

Ohioan Region

Ohio River System

Wabash River Drainage. *Indiana:* Wabash River, Posey Co. (MCZ). *Illinois:* Fox River, Richland Co.; Little Wabash River, Carmi, White Co.; (*both* MCZ).

Green River Drainage. *Kentucky:* Mud River, Rectors Bridge, 3 mi. E Dunmore, Muhlenberg Co.; Rough River, Dundee, Ohio Co.; (*both* MCZ). Pond River (MZUM).

Ohio River Drainage. *Ohio:* Ohio River, Cincinnati, Hamilton Co. (Sterki, 1907: 393).

Genus *Arkansia* Ortmann and Walker

Arkansia Ortmann and Walker 1912, Nautilus **25:** 97. Type species, *Arkansia wheeleri* Ortmann and Walker, original designation. This genus is monotypic.

Arkansia wheeleri Ortmann and Walker

Plate 11, figure 1
Distribution: Plate 8 A

Arkansia wheeleri Ortmann and Walker 1912, Nautilus **25:** 98, pl. 8 (Old River [a bayou of the Ouachita River], Arkadelphia, [Clark Co.], Arkansas; holotype MZUM 105514) Simpson, 1914, Cat. Naiades **1:** 478; Ortmann, 1921, Nautilus **34:** 141.

Description. Shell usually of medium size, reaching 80 mm in length, though occasionally exceeding 100 mm. Shell subrotund to subovate or subrhomboidal. Valves inflated, rather thick and solid. Anterior end regularly rounded. Posterior end somewhat truncate. Ventral margin regularly curved. Dorsal margin curved, forming a distinct angle with the obliquely descending posterior margin. Hinge ligament short. Anterior margin straight. Posterior ridge not prominent, usually rounded, but sometimes slightly biangulate. Umbos very prominent, projecting anteriorly and incurved over a large lunule, their sculpture consisting of two or three double-looped bars, the loops slightly swollen or tubercular; sculpture restricted to the extremity of the umbos. Posterior half of the disk sculptured with irregular, oblique folds, sometimes very faint, which curve upwards on the dorsal slope, and in front of the posterior ridge are crossed by numerous, irregular, radiating, small folds or wrinkles at right angles to the lines of growth; anterior portion of the disk smooth. Periostracum with a silky luster, dark reddish-brown or black, usually lighter toward the umbos, which in young shells are chestnut colored.

Left valve with two not strongly differentiated pseudocardinal teeth coalescing along the hinge line, the anterior one narrow and parallel with the hinge line, the posterior one somewhat wider and heavier, slightly separated from a strong projection of the interdentum, which is continuous with the lower lateral tooth and slopes gradually to its extremity; upper lateral low, the groove between deep, extending nearly to the umbo. Right valve with a single, strong pseudocardinal tooth, with a deep pit behind it to receive the anterior pseudocardinal tooth of the left valve, interdentum cut away to receive the interdental projection of the left valve; one short strong, lateral tooth. Muscle scars not much impressed. Nacre usually salmon colored above the pallial line, bluish-white, or entirely white below, rather thin, slightly iridescent with a wide, dark, prismatic border. Sexual differences not marked.

Length	Height	Width	
87	73	48	Old River, Arkadelphia, Clark Co., Arkansas. Paratype. Wheeler colln.
73.5	62	41	As above. Holotype MZUM.
35	33	23	As above. Paratype. Wheeler colln.

Anatomy and Breeding Season. The anatomy was discussed by Ortmann and Walker (1912, Nautilus **25:** 97–99) and on the basis of it, they recognized that this species belonged to the subfamily

Anodontinae. The species is bradytictic (Wheeler, 1918: 113).

Habitat. "Found in the shallow waters both on the sand bars and muddy bottoms, but like other anodontine species they prefer the oozy mud of the river margins where there is little or no current" (Wheeler, 1918: 113).

Remarks. Arkansia wheeleri Ortmann and Walker is not very closely related to any other species, except *Arcidens confragosus* (Say), a widely distributed species. In general, their external appearance is somewhat similar. In both the smaller series of radiating wrinkles and the curved folds on the dorsal slope are very much alike. Both have strong, oblique folds on the posterior half of the disk, but those of *Arkansia* more closely resemble those of *Amblema plicata* (Say). *Arkansia* has a heavier more inflated shell; the umbos are fuller, more projecting, and more anterior. The umbonal sculpture of *Arkansia* is comparatively simple and confined to the upper umbo, whereas that of *Arcidens* is developed into strong pitched up nodules, at the base of the loops, and extends out onto the disk. The lateral teeth are better developed in *Arkansia* than in *Arcidens*, but the presence of the interdental projection in the left valve and the cutting away of the interdentum in the right valve opposite it, relates *Arkansia*, *Arcidens* and *Lasmigona*.

The Wheeler collection is in the Alabama Museum of Natural History, University of Alabama, University, Alabama, but was not available for study.

Range. Found only in the Ozarkian Region: below the Ozark Crest in the upper Red and Black river systems.

Abundance. "Has apparently never been found in numbers. The only recent record is from the Kiamichi River in Oklahoma" (Stansbery, 1970: 18).

Specimens Examined

Red River System

Kiamichi River Drainage. *Oklahoma:* Kiamichi River, Antlers, Pushmataha Co. (CM); Kiamichi River, 8.5 mi. NE Hugo, Choctaw Co. (USNM).

Little River Drainage. *Arkansas:* Little River, White Cliffs, Little River Co. (MZUM).

Black River System

Ouachita River Drainage. *Arkansas:* Ouachita River and Old River, *both* Arkadelphia, Clark Co. (*both* MCZ and MZUM).

Tribe LAMPSILINI
Genus *Actinonaias* Crosse and Fischer

Actinonaias Crosse and Fischer 1893, Recherches Zoologiques ... de l'Amerique Centrale et du Mexique, Pt. 7, **2**: 600. Type species, *Unio sapotalensis* Lea, monotypic. Frierson, 1917, Nautilus **31**: 48. Ortmann, 1919, Mem. Carnegie Mus. **8**: 232.

Ortmanniana Frierson 1927, Check list N American naiades, pp. 11, 79. Type species, *Unio carinatus* Barnes, original designation.

Venustaconcha Frierson 1927, Check list N American naiades, pp. 11, 81, Errata et corrigenda. Type species, *Unio venustus* Lea, original designation.

Actinonaias rafinesqueana (Frierson)
Plate 11, figures 2–4
Distribution: Plate 8 B

Lampsilis rafinesqueana Frierson 1927, Check list N American naiades, p. 69 ([Illinois River], Moodys, [Cherokee Co.], Oklahoma; holotype MZUM 87576 figured by Frierson, 1928, Nautilus **41**: 138, pl. 1, figs. 1, 2).

Actinonaias streckeri Valentine and Stansbery 1972, Sterkiana no. 42, p. 32, non Frierson 1927.

Description. Shell medium to large, often exceeding 100 mm in length. Outline long, elliptical. Valves subinflated, subsolid, slightly inequilateral. Anterior end regularly rounded. Posterior end ending in a point or biangulation below the medial line. Ventral margin regularly curved. Dorsal margin straight, forming an angle with the obliquely descending posterior margin. Hinge ligament long. Posterior ridge generally indistinct and faintly double. Umbos rather full, not much projected above the hinge line, their sculpture not observed, located con-

siderably forward of the middle of the shell. Surface of the shell smooth, except for wide growth rests. Periostracum dirty yellowish-green, or tawny, often marked by faint, broad, broken, greenish rays.

Left valve with two triangular pseudocardinal teeth of about equal height, and two lateral teeth. Right valve with a strong tooth in front of the umbo, with a smaller one before it. Interdentum narrow and flat. One lateral tooth. Anterior and posterior muscle scars, and pallial line, all well impressed. Nacre bluish-white to creamy, with a wide prismatic border.

Male shells are long elliptical, somewhat biangulate, posteriorly. Female shells are more rounded and expanded posteriorly, having a slight, wide marsupial swelling. Both male and female shells gape slightly at the anterior base.

Length mm	Height mm	Width mm	
104	62	35	White River, Cotter, Baxter Co., Arkansas. Male.
86	60	35	[Illinois River], Moodys, Cherokee Co., Oklahoma. Holotype. Female.

Anatomy and Breeding Season. Gordon (pers. comm.) has studied the anatomy, and in a work in preparation, on the basis of the "mantle flaps" will show that this species belongs in the genus *Lampsilis*. If this is so, then arguing heuristically, so will *A. pectorosa*.

Remarks. Actinonaias rafinesqueana (Frierson) bears a very close resemblance to the Cumberlandian species, *A. pectorosa* (Conrad). Females, of the former species, are more fan shaped posteriorly, and while both species generally have a similar dirty yellowish green periostracum, most specimens of *rafinesqueana* are generally slightly rayed or rayless, whereas specimens of *pectorosa* are almost always rayed. In both species the rays, when present, are characteristically broken.

In the Ozarkian Region, *rafinesqueana* can be confused with *A. ligamentina* (Lamarck), but the latter has a much heavier shell, a stronger posterior ridge, is more heavily rayed, and usually has a more greenish or brownish periostracum. *A. rafinesqueana* has also been confused with *Lampsilis powelli* (Lea), but the latter shell is proportionally longer, brighter yellow, and is without rays.

Range. Found only in the Ozarkian Region, below the Ozark Crest, in the upper Arkansas and White river systems.

Abundance. Apparently never taken in large numbers.

Specimens Examined

Arkansas River System

Verdigris River Drainage. *Oklahoma:* Verdigris River (Gordon, pers. comm.).

Neosho River Drainage. *Missouri:* Spring River [Jasper Co.]; Elk River, [McDonald Co.] (*both* Nordstrom *et al.* 1977: 19); Indian Creek [of Elk River]; McDonald Co. (figured allotype, MZUM [lost]).

Illinois River Drainage. *Oklahoma:* [Illinois River], Moodys, Cherokee Co. (Holotype MZUM 87576; paratypes MZUM 90665; paratype ANSP 145238).

White River System

White River Drainage. *Arkansas:* White River, Monte Ne, Benton Co.; White River, Cotter, Baxter Co. (*both* MCZ).

Black River Drainage. *Arkansas:* Black River (MZUM).

Genus *Lampsilis* Rafinesque

Lampsilis Rafinesque 1820, Ann. Gén. des Sci. Physiques (Bruxelles) **5**: 298. Type species, *Unio ovatus* Say, subsequent designation. Herrmannsen, 1847, Indicis Generum Malacozoorum **1**: 575. Frierson (1927: 11, 79) introduced under *Lampsilis*, the subgenus *Ortmanniana*. Type species, *Unio carinatus* Barnes, original designation. He included *L. abrupta* and *higginsi* in this subgenus. Ortmann (1919: 233) had already placed *carinatus* [=*ligamentina* (Lamarck)] under *Actinonaias* Crosse and Fisher 1893 because its anatomy was not that of a *Lampsilis*.

Lampsilis abrupta (Say)
Plate 12, figures 1, 2
Distribution: Plate 2

Unio abruptus Say 1831, American Conch. no. 2 [letter press], pl. 17 (Wabash [River, New Harmony, Posey Co., Indiana], type ANSP [lost], *teste* Johnson and Baker, 1973, Proc. Acad. Nat. Sci. Phila. **125:** 146).

Unio cyclips Rafinesque 1831. Cont. Monog. Bivalve Shells River Ohio, p. 2 (river[s] Ohio and Mississippi, type ANSP [lost], *teste* Johnson and Baker, 1973, Proc. Acad. Nat. Sci. Phila. **125:** 146).

Unio orbiculatus Lea 1836, Synopsis Naiades, p. 25, *non* Hildreth 1827.

Unio crassus Conrad 1836, Monography Unionidae, no. 2, p. 34, pl. 16 (rivers of Ohio, Indiana and Illinois, type ANSP [lost], *teste* Johnson and Baker, 1973, Proc. Acad. Nat. Sci. Phila. **125:** 145) *non* Say 1817.

Lampsilis orbiculata Simpson 1914, Cat. Naiades **1:** 76. Coker, 1919, Bull. U. S. Bur. Fisheries for 1917–18, **36:** 29, pl. 14, lower fig. Ortmann, 1919, Mem. Carnegie Mus. **8:** 320 [description *partim*], pl. 20, fig. 8, pl. 21, figs. 1, 2. Neel and Allen, 1964, Malacologia **1:** 448, fig. 53. Parmalee, 1967, Illinois State Mus. Pop. Sci. Ser. **8:** 67, pl. 23 B. La Rocque, 1967, Ohio Geol. Surv. Bull. no. 62 (2): 217, fig. 103, fig. 104 distributional map [*partim*]. *All non* Hildreth 1827.

Lampsilis (*Ortmanniana*) *abrupta* (Say). Frierson, 1927, Check list N American naiades, p. 80. Haas, 1969, Das Tierreich, pt. 88, p. 461.

Lampsilis orbiculata forma *orbiculata*. Starrett, 1971, Illinois Nat. Hist. Surv. Bull. **30** (5): 338.

Description. Shell medium to large, sometimes exceeding 100 mm in length. Outline subelliptical, subovate or subquadrate; gaping at the anterior base. Valves somewhat inflated; extremely thick and heavy. Anterior end regularly rounded; posterior end pointed in males, abruptly truncated in females. Ventral margin regularly rounded in males, almost straight in females. Dorsal margin short and slightly curved, forming an indistinct angle with the obliquely descending posterior margin. Hinge ligament long and full. Posterior ridge visible in males and younger specimens, indistinct in older females. Posterior slope slightly convex or flattened, narrow. Umbos moderately inflated, projecting a little above the hinge line, their sculpture not distinct, more or less inclined forward, located in front of the middle of the shell. Surface of the shell smooth, except for wide, low, concentric ridges. The rest periods are often marked by a sulcus. Periostracum subshiny or dull, light or dark, yellow, yellowish brown. Rays, seldom present, except in younger shells; when visible they are grayish green or brownish and are usually fine and widely spaced.

Left valve with two triangular pseudocardinal teeth of about equal height, two curved lateral ones. Right valve with one high triangular pseudocardinal, with a smaller low one before and behind it. Interdentum narrow and flat. One strong lateral tooth. Anterior and posterior adductor muscle scars, and pallial line, all well impressed. Nacre generally silvery-white, iridescent, sometimes salmon tinted.

Male shells are subelliptical or subovate, the regularly curved ventral and posterior margins meeting in a blunt point mid-way from the base. Female shells develop a post-basal swelling which renders them posteriorly subtruncate or subquadrate in outline.

Length mm	Height mm	Width mm	
103	75	61	Ohio River, Portsmouth, Scioto Co., Ohio. Male. (CM).
93	65	43	Ohio River. Male.
92	83	57	Ohio River, Industry, Beaver Co., Pennsylvania. Female. (CM).
73	68	42	Ohio River. Female.

Anatomy and Breeding Season. The anatomy was discussed by Ortmann (1912: 353) and Simpson (1914: 76). The glochidia were figured by Ortmann (1911, pl. 89, fig. 22) 0.19 × 0.21 and 0.20 × 0.25 mm. This species is bradytictic (Ortmann, 1919: 323).

Habitat. Found on riffles in the strong currents of large rivers (Ortmann, 1919: 324).

Remarks. Lampsilis abrupta (Say) in

the Cumberlandian and Ohioan regions is easily recognized, except for young shells, by the thickness of the shell, which for its size is probably the heaviest shell in those regions. Also characteristic is its yellowish brown periostracum which may have narrow, widely spaced green rays. Young males resemble those of *Actinonaias ligamentina* (Lamarck) but the latter usually have wide green rays which are close together. The female of *L. abrupta* does not resemble *A. ligamentina*. In the Mississippian and the Ohioan regions *L. abrupta* may be mistaken for *L. higginsi* (Lea), see: Remarks.

Frierson (1924: 135) showed that Lea (1836: 25) had mischievously misidentified *Unio orbiculatus* Hildreth 1827 as *Unio abruptus* Say 1831. Hildreth's type measured 100 mm in length, 100 mm in height, and had a purple [or] violet nacre. These data clearly indicate that *orbiculatus* is not *abruptus* Say which is never as long as wide, and does not have a purple nacre. In a sample of 74 specimens of *L. abrupta*, Ball (1922: 113) was unable to reconcile Hildreth's measurements with those of his specimens. *Unio orbiculatus* Hildreth is *Obovaria retusa* (Lamarck 1819).

Range. Cumberlandian Region: Tennessee and Cumberland river systems. Ohioan Region: Monongahela and Allegheny rivers above maximum glaciation; Ohio River proper; and the Wabash, Scioto, and Muskingum rivers; St. Lawrence River System, western Lake Erie. Mississippian Region: Illinois River drainage, Illinois.

Abundance. Apparently never taken in large quantities. Ortmann (1919: 323) found it most abundant in the Ohio River, Beaver Co., Pennsylvania, and said that he had not collected more than two dozen specimens below Pennsylvania. Stansbery (1970: 19) said that "This species is still taken occasionally in the Tennessee River below Wilson and Guntersville Dams, and rarely in the Muskingum River, Ohio."

Specimens Examined

Mississippian Region

Mississippi River System

Illinois River Drainage. *Illinois:* Illinois River, 1 mi. below Hardin, Calhoun Co. (Bartsch, USNM); Illinois River, Peoria Lake, Chillicothe, (*both* Danglade), *both* Peoria Co.; Illinois River, La Salle, La Salle Co. (MZUM).

Ohioan Region

Ohio River System

Ohio River Drainage. *Illinois:* Ohio River, Brookport, Massac Co. (Parmelee). *Kentucky:* Ohio River, Paducah, McCracken Co. (Bartsch, USNM).

Cumberlandian Region

Tennessee River System

Clinch River Drainage. *Tennessee:* Clinch River, Offutt (CM); Clinch River, .5 mi. below dam at Norris (MZUM); *both* Anderson Co.; Clinch River, Solway, Knox Co. (CM).

Holston River Drainage. *Tennessee:* Holston River (MZUM).

French Broad River Drainage. *Tennessee:* French Broad River (MCZ).

Tennessee River Drainage. *Tennessee:* Tennessee River, Washington Ferry, Meigs Co. (MZUM).

Flint River Drainage. *Tennessee:* Flint River (MZUM).

Tennessee River Drainage. *Alabama:* Tennessee River, 11 mi. S Huntsville, Madison Co. (MZUM).

Limestone Creek Drainage. *Alabama:* Limestone Creek, The Points, Mooresville, Limestone Co. (MZUM).

Tennessee River Drainage. *Alabama:* Tennessee River, Decatur, Morgan Co. (MZUM); Tennessee River, Muscle Shoals (MZUM), Florence (MCZ, MZUM), *both* Lauderdale Co.; Tennessee River, Tuscumbia, Colbert Co. (MCZ).

Duck River Drainage: *Tennessee:* Duck River, Columbia, Maury Co. (MZUM).

Tennessee River Drainage. *Tennessee:* Tennessee River, Trotter's Landing, Humphreys Co. (MZUM). Tennessee River, 1 mi. above Fort Henry, Steward Co. (MZUM).

Cumberland River System

Cumberland River Drainage. *Kentucky:* Cumberland River, Robertsport; Monticello; (*both* MZUM) *both* Wayne Co. Cumberland River, below Wolf Creek Dam; Horse Shoe Bottom Ferry; below Rowena; (*all* MZUM) *all* Russell Co. Cumberland River, Burkesville; Neely's Ferry, 4 mi. S Burkesville; (*both* MZUM) *both* Cumberland Co.

Obey River Drainage. *Tennessee:* Obey River, mouth of Jolly Creek, Picket Co. (MZUM). Obey River, mouth of Horse Creek, Clay Co. (MZUM).

Cumberland River Drainage. *Tennessee:* Cumberland River, Hartsville, Trousdale Co. (Manning coll'n.). Nashville, Davidson Co. (MCZ). Cumberland River, Gowers Island [between Nashville and Dover] (MZUM).

Ohioan Region

Ohio River System

Wabash River Drainage. *Indiana:* Wabash River, Lafayette, Tippecanoe Co. (MZUM). White River (Call, 1898: 493).

Ohio River Drainage. *Indiana:* Ohio River, Vevay, Switzerland Co. (MZUM). *Ohio:* Ohio River, Constance, Boone Co. (MCZ). Ohio River, Cincinnati, Hamilton Co. (MCZ; MZUM). Ohio River, below New Richmond, Clermont Co. (MZUM).

Scioto River Drainage. *Ohio:* Scioto River, Chillicothe, Ross Co. (MZUM).

Ohio River Drainage. *Ohio:* Ohio River, Portsmouth, Scioto Co. (CM). Ohio River, Portland, Meigs Co. (CM). *West Virginia:* Ohio River, Parkersburg, Wood Co. (CM). *Ohio:* Ohio River, Marietta, Washington Co. (MCZ).

Muskingum River Drainage. *Ohio:* Muskingum River (Stansbery, 1970: 19).

Ohio River Drainage. *West Virginia:* Ohio River, St. Marys, Pleasants Co. (CM). *Ohio:* Ohio River, Toronto (CM); Shanghae [Knox Township] (MCZ); *both* Jefferson Co. *Pennsylvania:* Ohio River, Industry, Cooks Ferry, Shippingport; (*all* CM) *all* Beaver Co.

Allegheny River Drainage. *Pennsylvania:* Allegheny River, Kelly, Godfrey; (*both* CM) *both* Armstrong Co.

Monongahela River Drainage. *Pennsylvania:* Monongahela River, Charleroi, Washington Co. (CM).

St. Lawrence River System

Great Lakes Drainage (Lake Erie): Niagara River, Buffalo, [Erie Co.]. The single specimen collected by Miss Walker in 1906, reported by Robertson and Blakeslee (1948: 111), as in the Buffalo Museum of Science, could not be located (H. W. Charnley, pers. comm.). Since Robertson and Blakeslee describe *A. ligamentina*, and the above specimen separately, the record is accepted as authentic.

Lampsilis higginsi (Lea)

Plate 13, figures 1, 2
Distribution: Plate 2

Unio higginsii Lea 1857, Proc. Acad. Nat. Sci. Phila. **9:** 84 ([Mississippi River], Muscatine, [Muscatine Co.], Iowa); 1862, Jour. Acad. Nat. Sci. Phila. (2) **5:** 188, pl. 24, fig. 258, figured holotype USNM 84823; 1863, Obs. Unio **9:** 10.

Lampsilis higginsii grandis Simpson 1914, Cat. Naiades **1:** 78 (Illinois River, near Utica, [Lasalle Co.], Illinois, type USNM [lost]).

Lampsilis higginsii (Lea). Simpson 1914, Cat. Naiades **1:** 78. Utterback, 1916, Amer. Midl. Nat. **4:** 445 [182], pl. 28, figs. 105 A and B. Coker, 1919, Bull. U. S. Bur. Fisheries for 1917–18, **36:** 29, pl. 14, middle pair. Baker, 1928, Wisconsin Geol. and Nat. Hist. Surv., Bull. **70:** (2): 293, pl. 95, Parmalee, 1967, Illinois State Mus. Pop. Sci. Ser. **8:** 67, pl. 23: A.

Lampsilis (*Ortmanniana*) *higginsii* (Lea). Frierson, 1927, Check list N American naiades, p. 80. Haas, 1969, Das Tierreich, pt. 88, p. 461.

Lampsilis orbiculata forma *higginsii* (Lea). Starrett, 1971, Illinois Nat. Hist. Surv. Bull. **30** (5): 339.

Description. Shell medium to large, sometimes exceeding 100 mm in length. Outline elliptical, oval, or rhomboid, gaping at the anterior base. Valves much inflated, thick and heavy. Anterior end regularly rounded; posterior end somewhat pointed in males; truncated or subtruncated in females. Ventral and dorsal margins slightly curved, the latter forming an indistinct angle with the obliquely descending posterior margin. Hinge ligament long and full. Posterior ridge rather sharp in some males and younger specimens, indistinct in older females. Posterior slope slightly convex or flattened, narrow. Umbos swollen, inflated, considerably raised above the hinge line, their sculpture consisting of a few, slightly looped, feeble ridges, located considerably forward of the middle of the shell. Surface of the shell smooth, except for wide, low, concentric ridges. The rest periods are often marked by a sulcus. Periostracum usually dull and dark, yellowish to olive. Rays frequently present, green and often wide.

Left valve with two triangular pseudocardinal teeth of about equal height, two curved lateral ones. Right valve with one high triangular pseudocardinal, with a smaller low one before and behind it. Interdentum narrow and flat. One strong lateral tooth. Anterior and posterior adductor muscle scars, and pallial line, all well impressed. Nacre generally silvery-white, iridescent, sometimes salmon tinted, yellowish or orange.

Male shells are elliptical or oval, the regularly curved, ventral dorsal margins meeting, often imperceptibly, mid-way from the base. Female shells develop a post-basal swelling which renders them posteriorly subtruncate and rhomboidal in outline. They also become greatly inflated.

Length mm	Height mm	Width mm	
97	68	56	Mississippi River, Mercer Co., Illinois. Male.
88	63	45	Illinois River, Illinois. Male.
100	76	69	Illinois River, Meredosia, Morgan Co., Illinois. Female.
91	69	63	Mississippi River, Davenport, Scott Co., Iowa. Female (MZUM).
96	72	59	Spring River, Lawrence Co., Arkansas. Male. (MZUM).
78	62	45	Old River, Arkadelphia, Clark Co., Arkansas. Female (MZUM).

Anatomy and Breeding Season. The anatomy of *higginsi* and *abrupta* have not been separately discussed. A glochidium of the former was figured by Surber (1912: 9, pl. 2, fig. 23) which measured 0.21 × 0.26 mm. He also (1912: 7) indicated that this species is bradytictic, and (1913: 107) that *Stizostedion canadense* (Smith) is [at least one of] its natural host fish.

Habitat. Found on riffles in the strong currents of large rivers.

Remarks. In the Mississippian region *Lampsilis higginsi* can be confused with *Obovaria olivaria* (Rafinesque), but the latter has a more regularly ovate shell, fine, rather than broad green rays, and more especially it has only a slight interdentum between the most posterior pseudocardinal tooth and the lateral teeth in the right valve and none in the left valve. *L. abrupta* and *higginsi* overlap in their distribution in the Illinois and lower Ohio rivers.

Simpson (1914: 76, 78) correctly described *L. abrupta* and *higginsi.* Ortmann (1919: 320) included both in his description, and suggested there was only one species, as did H. and A. van der Schalie (1950: 456). An examination of the specimens available to them revealed misidentifications which led to their erroneous conclusion. Morrison in writing to Starrett (1971: 338) noted that, "The geographic range of *abruptus* overlaps that of *higginsi* in the region of the Ohio-Mississippi confluence," and that they were distinct species. Starrett (1971: 338), however, followed the classification

suggested by Stansbery which implies they are a single species, since "forms" have no status in modern nomenclature. Stansbery and Kokai (1979: 57) later suggested, "that there are several distinct taxa within this [*Lampsilis orbiculata*] complex," without any further elucidation.

L. higginsi differs from *abrupta* in that the former has umbos which are much higher and fuller. The shells of both sexes in *L. higginsi* are more inflated, the females often being very bulbous, while those of *abruptus* are rather flat sided. *L. higginsi* has a darker greenish periostracum in contrast to the yellowish periostracum of *abrupta*. The rays of *L. higginsi* are broader and green rather than grayish green or brownish as in *abrupta*.

Range. Ozarkian Region: below the Ozark Crest in the Black and White river systems; and above it in the Meramec and Gasconade river systems. Mississippian Region: Illinois River; Mississippi River from Illinois north to Wisconsin. Ohioan Region: lower Ohio River, Illinois. Listed by Gordon, *et al.* (1980: 35) as occurring in the Little River Drainage of the Red River System, Arkansas. These specimens, in the MZUM, were examined by the author and are *Lampsilis satur* (Lea), a species not included in their list.

Abundance. "Is a rather uncommon species, but a few may be found in almost any carload of mixed shells" (Coker 1919: 29). "Is known living today only in the upper Mississippi River" (Stansbery 1970: 19). Listed as a rare and endangered species by Stansbery (1971: 15). In the area between Pairie du Chien, Crawford Co., Wisconsin and Harpers Ferry, Alamakee Co., Iowa, Mathiak (1979: 57, pl. 3, 10 C) collected 40 live specimens in five days during 1975. He said that, "in any calculation taking into account the number of tons of shells being processed [by fisheries] daily, the number of Higgin's Eye mussels I found in a few hours would lead to the conclusion that hundreds had actually been harvested in 1975." He further noted, "no one working with the endangered species program took the opportunity to search for the Higgin's Eye or other rare mussels during [1974–1975] when all the species were being harvested from the Prairie du Chien area." The collecting by Fuller (1978: 3) offers further evidence that *L. higginsi* is probably about as abundant in the upper Mississippi River as it was early in the century. It would appear that this species was placed on the endangered list by over enthusiastic bureaucrats. This would be of little importance if it did not lead directly to the unnecessary harassment of commercial fishermen.

Specimens Examined

Ozarkian Region

Black River System

Ouachita River Drainage. *Arkansas:* Ouachita River (MZUM), Old River (MZUM, CM), *both* Arkadelphia, Clark Co.

Saline River Drainage. *Arkansas:* Sabine [sic] = Saline River (Stansbery, 1970: 19).

White River System

White River Drainage. *Arkansas:* North Fork White River, nr. Norfork, Baxter Co. (MCZ).

Black River Drainage. *Arkansas:* Black River, above Pocahontas, Randolph Co. (MZUM, CM): Black River, Black Rock, Lawrence Co. (MCZ, MZUM, USNM).

Spring River Drainage. Spring River [Lawrence Co.] (MZUM).

Meramec River System

Meramec River Drainage. *Missouri:* Meramec River, Crawford, Franklin, and St. Louis Cos. (Buchanan).

Gasconade River System

Gasconade River Drainage. *Missouri:* Gasconade River (Stansbery, 1970: 19).

Mississippian Region

Missouri River System

Missouri River Drainage. *Nebraska:* Nemeha River (Aughey, 1877: 702).

Mississippi River System

Illinois River Drainage. *Illinois:* Illinois River, 1 mi. below Hardin (Bartsch, USNM; MZUM); Kampsville (Danglade); *both* Calhoun Co. Illinois River, Florence, Pike Co. (Danglade). Illinois River, Meredosia, Morgan Co. (MCZ). Illinois River, Beardstown, Cass Co. (Danglade). Illinois River, Bath (Danglade); Havana (MZUM); *both* Mason Co. Illinois River, Peoria (Danglade; Parmalee); Chillicothe (Danglade); *both* Peoria Co. Illinois River, Marquette, Bureau Co. (Shimek, USNM). Illinois River, nr. Utica, La Salle Co. (Simpson). Illinois River, Morris, Grundy Co. (Shimek; USNM). Kankakee River (MZUM).

Mississippi River Drainage. *Missouri:* Mississippi River, Louisiana, Pike Co. (Utterback). Mississippi River, Hannibal, Marion Co. (Utterback). *Iowa:* Mississippi River, Montrose, Lee Co. (Bartsch, USNM). Iowa River, Iowa City, Johnson Co. (Shimek, USNM). Mississippi River, Muscatine (USNM); Fairport (Morrison, USNM); Montpelier (Bartsch, USNM); *all* Muscatine Co. Mississippi River, Buffalo (MZUM); Davenport (MCZ); Princeton (Bartsch, USNM); *all* Scott Co., Crooked Slough, 1 mi. N Bellevue, Jackson Co. (Bartsch, USNM). Mississippi River, Dubuque, Dubuque Co. (Sharpe, USNM). *Wisconsin:* Wisconsin River, Arena, Iowa Co. (MCZ). Mississippi River, Prairie du Chien (Stansbery, Ohio State Museum 38489, 21 fresh specimens, 1976); Lynxville (Bartsch USNM); *both* Crawford Co. Mississippi River, Victory; Genoa; Stoddard; (*all* Bartsch, USNM); *all* Vernon Co. Black River, between R. R. bridge and La Crosse, La Crosse Co. (Bartsch, USNM). *Minnesota:* Mississippi River Dresback, Winona Co. (Bartsch, USNM). *Wisconsin:* Mississippi River, Buffalo, Buffalo Co. (Grier). *Minnesota:* Lake Pepin, Red Wing, Goodhue Co. (MCZ; USNM). *Wisconsin:* Mississippi River, above Prescott, Pierce Co. (Bartsch, USNM). St. Croix River, Hudson, St. Croix Co. (MZUM).

Ohioan Region

Ohio River System

Ohio River Drainage. *Illinois:* Ohio River, Hillerman, Massac Co. (Bartsch, USNM).

Lampsilis powelli (Lea)

Plate 15, figures 3, 4

Distribution: Plate 8 B

Unio powellii Lea 1852, Trans. Amer. Philos. Soc. **10:** 270, pl. 19, fig. 25 (Saline River, Arkansas; figured holotype USNM 85042); 1852, Obs. Unio **5:** 26.

Lampsilis powellii (Lea). Simpson, 1914, Cat. Naiades **1:** 75. Scammon, 1906, Kansas Univ. Sci. Bull. **3:** 288. Utterback, 1916, Amer. Midl. Nat. **4:** 446 [183], pl. 28, fig. 103 A, B [figured as *L. luteola*], Black River, Williamsville, Wayne Co., Missouri, MCZ 271445. Isely, 1925, Proc. Oklahoma Acad. Sci. **4:** 111.

Description. Shell generally of medium size, occasionally large, exceeding 100 mm in length. Outline elliptical or long obovate. Valves subinflated, rather thin to subsolid. Anterior end regularly rounded. Posterior end somewhat pointed. Ventral margin regularly curved, or straight. Dorsal margin straight forming a barely perceptable angle with the obliquely descending posterior margin. Hinge ligament long. Posterior ridge indistinct. Umbos moderately full, slightly projected above the hinge line, their sculpture consisting of double looped corrugations, located considerably forward of the middle of the shell. Surface of the shell smooth except for growth rests. Periostracum generally shining, olive-brown, tawny, and always without rays.

Left valve with two triangular pseudocardinal teeth (the anterior one higher), and with two lateral teeth. Right valve

with one strong pseudocardinal tooth in front of the umbo and with a smaller one before it. Interdentum very narrow. One lateral tooth. Anterior adductor muscle scars well impressed, posterior ones less so. Pallial line visible anteriorly. Nacre bluish white and iridescent.

Male shells are feebly biangulate posteriorly, near the medial line. Female shells are wider and rounder posteriorly.

Length mm	Height mm	Width mm	
80	56	29	Saline River, Arkansas. Holotype. Male.
77	39	24	As above. Allotype. Female.

Anatomy and Breeding Season. Unknown.

Remarks. Lampsilis powelli (Lea) bears a very close resemblance to the Cumberlandian species, *L. virescens* (Lea) which is found only in the Tennessee River system, mainly in the Paint Rock River drainage. Shells of the former are always without rays, while those of *virescens* usually have green rays above the sometimes marked posterior ridge. In the Ozarkian Region, *powelli* has been confused with *L. radiata siliquoidea, hydiana, teres,* and *Villosa reeviana.* With the exception of *L. teres,* which is sometimes without rays, all of these other species are rayed to some degree. *L. powelli* differs from *teres,* in that the latter is more elongate, and pointed, much more inflated, and the females exhibit more sexual dimorphism.

Range. Found only in the Ozarkian Region, below the Ozark Crest, in the Saline River drainage of the Black River system; the upper Arkansas, and upper White River systems.

Abundance. Apparently never taken in large numbers.

Specimens Examined

Black River System

Saline River Drainage. *Arkansas:* Saline River, Benton, Saline Co. (MCZ, MZUM).

Arkansas River System

Neosho River Drainage. *Kansas:* Neosho River, Oswego (Scammon, 1906: 288); Chetopa (Isely, 1925, Table 2); *both* Labette Co. Spring River, Baxter Springs, Cherokee Co. (MCZ). *Missouri:* Elk River, McDonald Co. (Utterback, 1916: 183).

Illinois River Drainage. *Oklahoma:* Illinois River, Moodys, Cherokee Co. (Isely, 1925: 67).

White River System

White River Drainage. *Missouri:* White River (Utterback, 1917, Table).

Black River Drainage. *Missouri:* Black River, Williamsville, Wayne Co. (MCZ).

Genus *Proptera* Rafinesque

Potamilis Rafinesque 1818, Amer. Monthly Mag. and Critical Rev. [New York] **3:** 355. Type species, *Unio alatus* Say, monotypic. In 1818, 23 of the 24 taxa listed under *Potamilis* were *nomina nuda.* Morrison (1969: 24) correctly stated that no. 12, *P. alatus* is *Unio alatus* Say 1817. Say had sent Rafinesque a copy of his article from the first edition of *Nicholson's Encyclopedia* (Johnson, 1975: 265).

Proptera Rafinesque 1819, Jour. Phys. Chim. Hist. Nat. [Paris] **88:** 426. Type species, *Unio alatus* Say. Subsequent designation, Herrmannsen, 1847, Indicis Generum Malacozoorum **2:** 41, under *Metaptera* Rafinesque, an objective synonym of *Proptera. Metaptera* Rafinesque 1820, Ann. Gén. Sci. Physiques, Bruxelles **5:** 299. Rafinesque deemed *Proptera* inappropriate. *Potamilis* was overlooked from 1818 until its availability was indicated by Morrison (1969: 24). It was adopted by Valentine and Stansbery (1971: 25), and has since been promulgated by the latter. *Proptera* has been in general usage since 1900 (Simpson, 566). As no question of priority of authorship is involved, the resurrection of *Potamilis* appears nugatory. The most recent revision of the *Rules* (1974, Bull. Zool. Nomencl. **31** (2): 80) under Article 23, states: "A zoologist who considers that the application of the Law of Priority would in his judgment disturb stability or universality or cause confusion is to maintain the existing usage and must refer the case to the Commission for a decision under the plenary powers [Art. 79]." This author maintains existing usage, and suggests that those who would promulgate *Potamilus* seek the ruling.

Proptera capax (Green)

Plate 16, figures 1, 2

Distribution: Plate 3

Unio capax Green 1832, Cabinet of Nat. Hist. and Amer. Rural Sports **2:** 290 ([Mississippi River],

Falls of St. Anthony [Minneapolis, Hennepin Co., Minnesota], type [lost]; Bayou Teche [error]).

Symphynota globosa Lea 1832, Trans. Amer. Philos. Soc. **5:** 41, pl. 4, fig. 12 (River Ohio, 150 miles below Louisville [Kentucky], figured type [lost]; syntypes ANSP 56609); 1834, Obs. Unio **1:** 153. Lea (1852, Synopsis of Naiades, third edit., p. 27) acknowledged that *capax* had priority over *globosa*.

Lampsilis capax (Green). Smith, 1899, Bull. U. S. Bur. Fisheries for 1898, pl. 84. Simpson 1914, Cat. Naiades **1:** 76; Coker, 1919, Bull. U. S. Bur. Fisheries for 1917–18, **36:** 31, pl. 17, lower fig.

Proptera capax (Green). Ortmann, 1914, Nautilus **28:** 67. Utterback, 1916, Amer. Midl. Nat. **4:** 394 [162], pl. 26, figs. 93 A and B. Frierson, 1927, Check list N American naiades, p. 87. Baker, 1928, Wisconsin Geol. and Nat. Hist. Sur., Bull. **70** (2): 248, pl. 84, figs. 1–4. Parmalee, 1967, Illinois State Mus. Pop. Sci. Ser. **8:** 83, pl. 28: B. La Rocque, 1967, Ohio Geol. Surv. Bull. no. 62 (2): 260, fig. 149, fig. 150 distributional map. Starrett, 1971, Illinois Nat. Hist. Surv. Bull. **30** (5): 330.

Description. "The valves of this shell are much more convex or globose than any of the uniones which I have seen, and as they are quite thin compared with most of the western species, the cavity in which the animal is lodged is exceedingly capacious—hence its name. The anterior end is broad, rounded, and slightly angular near the hinge; the posterior margin is very narrow, and also rounded; these valves do not close perfectly on each other, but gape at the opposite margins; this is more remarkable in old than in young individuals. The epidermis is smooth, yellowish, and frequently clouded with brown. The nacre is bluish white, and often very beautifully iridescent. The beaks are recurved over the tegument. The teeth resemble very much those of the *U. ovatus* of Mr. Say, but they are much thinner. These characters, I think, will be sufficient to distinguish the *Unio capax* from every other shell." The original description is quoted since it is quite unavailable, and because it is lucid.

Length mm	Height mm	Width mm	
128	90	74	Wabash River, New Harmony. Posey Co., Indiana.
92	77	61	As above.

Anatomy and Breeding Season. The anatomy was discussed by Ortmann (1914, Nautilus **24:** 67). The "axe-head" glochidium was figured by Coker and Surber (1911: 179, pl. 1, fig. 4, 4a). Reported gravid in June, July, August, and October (Surber, 1912: 7 and Ortmann, *loc. cit.*). Duration of the season not indicated.

Habitat. "Has been taken on both a sand and mud bottom, in flowing water, and at depths of only a few inches to eight feet or more" (Parmalee, 1967:83).

Remarks. Proptera capax (Green) may be easily recognized by its thin, globose shell with inflated umbos, and by its periostracum which is always rayless. It may be confused with *Lampsilis ovata* (Say) but the latter has a heavy shell, is not as globose, is generally rayed, and exhibits sexual dimorphism, which *capax* does not.

Coker and Surber (1911: 20) indicated that *capax* was not a *Lampsilis*, but a *Proptera*, where it was placed by Ortmann (1914, Nautilus **24:** 67).

Range. Found in the Ozarkian Region, only below the Ozark Crest, in the White and St. Francis river systems. Mississippian Region: Illinois River; Mississippi River from Illinois north to Minnesota. Ohioan Region; Wabash River; St. Lawrence River system, western Lake Erie and eastern Lake Ontario drainages.

Reported from the Arkansas River system, Neosho River, Lyon Co., Kansas, by Murray (1962, Nautilus **75:** 95). The single specimen found was figured by Murray and Leonard (1962: 132, pl. 36) and is a female of *Proptera purpurata* (Lamarck), with a heavy shell and characteristic purple nacre. The single male shell [no longer available] reported from the Verdigris River, Nowata Co., Oklahoma, by Branson (1963: 510), as *capax*, was probably also *P. purpurata*. *P. capax* does not exhibit sexual dimorphism.

Abundance. "Most numerous in the lower Ohio and Wabash rivers—especially in the latter" (Parmalee, 1967: 83). "Largely, if not entirely, gone from the

entire Ohio River drainage. This species still survives in the White and St. Francis rivers of Arkansas" (Stansbery, 1970: 18).

Specimens Examined

Ozarkian Region

White River System

White River Drainage. *Arkansas:* White River, 1 mi. NE Devall Bluff, Prairie Co. (MZUM).

St. Francis River System

St. Francis River Drainage. *Arkansas:* St. Francis River, Parkin (MCZ; MZUM); Wittsburg (Call); *both* Cross Co. St. Francis River, Madison, St. Francis Co. (MCZ; CM).

Mississippian Region

Missouri River System

Missouri River Drainage. *Nebraska:* Blue River; Elkhorn River (*both* Aughey, 1877: 702).

Mississippi River System

Mississippi River Drainage. *Illinois:* Mississippi River, Alton, Madison Co. (MCZ; MZUM).

Illinois River Drainage. *Illinois:* Illinois River, Grafton, Jersey Co. (Danglade). Illinois River, Kampsville, Calhoun Co. (Danglade). Illinois River, Pearl; Florence (*both* Danglade); *both* Pike Co. Illinois River, Beardstown, Cass Co. (Danglade). Sangamon River (Danglade). Illinois River, Havana, Mason Co. (Danglade). Spoon River, Fulton Co. (MZUM). Illinois River, Pekin, Tazewell Co. (Danglade). Illinois River, La Salle Co. (Calkins).

Mississippi River Drainage. *Illinois:* Mississippi River, Hamburg, Calhoun Co. (MCZ). *Missouri:* Mississippi River, Hannibal, Marion Co. (MCZ). Mississippi River, La Grange, Lewis Co. (Utterback). *Illinois:* Mississippi River, Hamilton (MZUM), Warsaw (MCZ); *both* Hancock Co. *Iowa:* Des Moines River, Keokuk, Lee Co. (MZUM). Mississippi River, Burlington, Des Moines Co. (MCZ). *Illinois:* Mississippi River, Mercer Co. (MCZ). *Illinois:* Mississippi River, Martins Landing, Rock Island Co. (MZUM). *Iowa:* Mississippi River, McGregor, Clayton Co. (MZUM). *Wisconsin:* Mississippi River, Alma, Buffalo Co. (MZUM). *Minnesota:* Mississippi River, Falls of St. Anthony, [Minneapolis, Hennepin Co.] (Green).

Ohio River System

Ohio River Drainage. *Illinois:* Ohio River, Hillerman, Massac Co. (USNM). Ohio River, Shawneetown, Gallatin Co. (MCZ).

Wabash River Drainage. *Illinois:* Wabash River, 2 mi. W Maunie, White Co. (Parmalee). *Indiana:* Wabash River, New Harmony, Posey Co. (MCZ). *Illinois:* Wabash River, Grayville, White Co. (USNM). *Indiana:* White River, Hazleton, Gibson Co. (MZUM). West Fork, White River, Strawtown, Hamilton Co. (MZUM).

St. Lawrence River System

Great Lakes Drainage (Lake Erie). *New York:* Niagara River, Buffalo, Erie Co. (Lake Ontario). *New York:* Wilson's Creek [= Twelvemile Creek, near Wilson], Niagara Co. These records (Robertson and Blakeslee 1948: 106) are based on specimens in the Buffalo Museum of Science, which have been examined and are authentic.

Genus *Villosa* Frierson

Micromya Agassiz 1852, Archiv für Naturgeschichte, **18** (1): 47. Type species, *Unio lapillus* Say, subsequent designation, Herrmannsen, 1852, Indicis Generum Malacozoorum, Supp. et Corr., p. 83, *non Micromya* Rondani 1840 (Insecta).

Villosa Frierson 1927, Check list N American naiades, pp. 11, 80. Type species, *Unio villosus* Wright, original designation.

Villosa arkansasensis (Lea)

Plate 16, figures 3, 4
Distribution: Plate 8 A

Unio arkansasensis Lea 1862, Proc. Acad. Nat. Sci. Phila. **14:** 169 ([Ouachita River] near Hot Springs, [Garland Co.], Arkansas); 1862, Jour. Acad. Nat. Sci. Phila. (2) **5:** 206, pl. 30, fig. 275, figured holotype USNM 25710; Obs. Unio **9:** 28. Call, 1895, Trans. Acad. Sci. St. Louis **7:** 6.

Lampsilis arkansasensis (Lea). Simpson, 1900, Proc. U. S. Natl. Mus. **22:** 557; 1914, Cat. Naiades **1:** 130.

Eurynia (*Micromya*) *arkansasensis* (Lea). Ortmann, 1916, Nautilus **30:** 54. Wheeler, 1918, Nautilus **31:** 118.

Description. Shell small in size, seldom exceeding 40 mm in length. Outline ovate, or short obovate. Valves subinflated, solid. Anterior end regularly rounded; posterior end somewhat pointed. Ventral margin regularly curved. Dorsal margin rather rounded, forming a more or less distinct angle with the obliquely descending posterior margin. Posterior ridge, low, almost double, ending a slight biangulation below the medial line. Hinge ligament short. Umbos not much swollen, slightly projected above the hinge line, the sculpture not observed, located in the anterior third of the shell. Surface of the shell with irregularly concentrical striations. Periostracum dull to subshiny, yellowish to brownish, usually with fine green rays over the entire surface.

Left valve with two rather heavy, triangular, pseudocardinal teeth of about equal size, and two short lateral teeth. Right valve with two pseudocardinals, the posterior one chunky, the more anterior tooth vestigial. No interdentum. One lateral tooth. Anterior adductor muscle scars well impressed, posterior ones faint. Pallial line visible anteriorly. Nacre silvery white, bluish, iridescent posteriorly.

Male shells are somewhat pointed. Female shells are more broadly rounded, and truncated below the medial line. In mature females there is a distinct "constriction" in the middle of this truncation.

Length mm	Height mm	Width mm	
40	28	18	[Ouachita River], Hot Springs, [Garland Co.], Arkansas. Holotype. Male.
38	27	18	Saline River, Benton, Saline Co., Arkansas. Female.

Anatomy and Breeding Season. The anatomy was discussed by Ortmann (1916, Nautilus **30:** 54).

Remarks. Villosa arkansasensis (Lea) is most closely related to the Cumberlandian species, *V. vanuxemensis vanuxemensis* (Lea). Shells of the former are more swollen, less elongate, and the umbos are located more anteriorly. Further, in females the enlarged and truncated posterior end is more evenly rounded, and not as produced as it is *V. v. vanuxemensis*. The periostracum of *arkansasensis* is usually yellowish to brownish and rayed. The nacre is always white. The periostracum of *vanuxemensis* is from dirty tawny through olive to nearly black, and is not always rayed. The nacre is very rarely white. It is usually dirty purplish-white, through salmon-tinted to dark purple. The most important similarity between the two species is the characteristic "constriction" on the posterior truncation of the female shells.

Range. Found only in the Ozarkian Region, below the Ozark Crest, in the upper Black River System.

Abundance. Never taken in large numbers.

Specimens Examined

Black River System

Ouachita River Drainage. *Arkansas:* Ouachita River, 3 mi. S.E. Pencil Bluff, Montgomery Co. (MCZ); Ouachita River, near Hot Springs, Garland Co. (USNM); Ouachita River, S Arkadelphia, Clark Co. (Wheeler).

Little Missouri River Drainage. *Arkansas:* Little Missouri River, Murfreesboro, Pike Co. (MZUM).

Caddo River Drainage. *Arkansas:* Caddo River (MZUM).

Saline River Drainage. *Arkansas:* Saline River, Benton (MCZ, MZUM); 3.5 mi. SE Traskwood (MCZ); *both* Saline Co.

Villosa reeviana (Lea)

Plate 17, figures 1–5

Distribution: Plate 7 B

Unio reevianus Lea 1852, Trans. Amer. Philos. Soc. **10:** 272, pl. 20, fig. 28 (Alexandria, Louisiana [erroneous]; holotype USNM 85025 male; paratype MCZ 178918 male, labeled, "Arkansas. Lea so decided from this specimen and another, Powell."; allotype USNM 85025a, labeled, "White River, Arkansas." The type locality is here restricted to: White River, Elkins, Washington Co., Arkansas); 1852, Obs. Unio **5:** 28.

Unio breviculus Call 1887, Proc. U. S. Natl. Mus. **10:** 499, pl. 28 (Currant [Current] River, Shannon Co., Missouri and in Jacks Fork and Big Creek, tributaries to it; lectotype selected by Johnson, 1975, Occ. Papers on Moll. **4** (54): 141, MCZ 5020, male specimen portrayed in figs. 1, 1a, 1b, from Jacks Fork [Shannon Co.]; figured allotype MCZ 5023 portrayed in figs. 2, 2a, 2b, from Big Creek [Fork], Texas Co.); 1895, Trans. Acad. Sci. St. Louis **7:** 6, pl. 17.

Lampsilis brittsi Simpson 1900, Proc. Acad. Nat. Sci. Phila. **52:** 76, pl. 5, figs. 1–2 (no locality [Niangua River, Camden Co., Missouri]; holotype USNM 152700).

Lampsilis reeviana (Lea). Simpson, 1914, Cat. Naiades **1:** 74. Utterback, 1916, Amer. Midl. Nat. **4:** 449 [186]. Frierson, 1927, Check list N American naiades, p. 73.

Lampsilis brevicula (Call). Simpson, 1914, Cat. Naiades, **1:** 57. Ortmann, 1918, Nautilus **32:** 14.

Eurynia (*Micromya*) *brevicula* (Call). Utterback, 1916, Amer. Midl. Nat. **4:** 434 [171], pl. 27, figs. 98 A–D.

Lampsilis reeviana brevicula (Call). Frierson 1927, Check list N American naiades, p. 73.

Lampsilis breviculus brittsi Simpson. 1900. Proc. U. S. Natl. Mus. **22:** 533. 1914, Cat. Naiades **1:** 58.

Eurynia (*Micromya*) *brevicula brittsi* (Simpson). Utterback, 1916, Amer. Midl. Nat. **4:** 435 [172], pl. 27, figs. 99 A, B.

Description. Shell of medium size, not exceeding 80 mm in length. Outline ovate, elliptical or obovate. Valves subinflated, rather thin to subsolid, inequilateral. Anterior end regularly rounded, posterior end more broadly rounded. Ventral margin slightly curved. Dorsal margin somewhat curved, forming a barely perceptible angle with the obliquely descending posterior margin. Hinge ligament is long, passing under the umbos and appearing anteriorly in front of a small lunule. Posterior ridge indistinct. Umbos are not very full, but slightly elevated above the hinge line, their sculpture not observed, located very anteriorly. Surface of the shell is smooth. Periostracum is generally shiny or subshiny, greenish straw color, having a smoky tint, or yellowish horn-color, with dark green rays, generally over the entire surface. The rays are usually delicate, and generally broken.

Left valve with two delicate, subcompressed pseudocardinal teeth. These are located anterior of the umbo, with the more anterior tooth being the higher. Of the two lateral teeth present, the inner tooth is the higher. Right valve with a somewhat compressed pseudocardinal tooth, with a smaller one above it separated by a deep, parallel-sided pit, often with the vestige of another tooth behind. Interdentum is very narrow and curved. One lateral tooth is truncate posteriorly. Muscle scars and umbonal cavities are shallow, pallial line only visible anteriorly. Nacre is whitish, pinkish, bluish white.

Male shells are quite elliptical, and faintly biangulate posteriorly. Female shells are shorter and higher than those of the male and strongly inflated post-basally. The low posterior ridge ends in a decided point about three-fifths of the way up from the base. The post-basal margin appears truncated. This truncation may be slightly to considerably emarginate.

Length mm	Height mm	Width mm	
75	41	28	[Arkansas] Holotype of *U. reevianus*. Male.
62	39	23	White River, Arkansas. Allotype of *U. reevianus*. Female.
64	40	24	Jacks Fork, Current River, Shannon Co., Missouri. Lectotype of *U. breviculus*. Male.

58	40	25	Big Fork, Current River, Texas Co., Missouri. Allotype of *U. breviculus*. Female.

Anatomy and Breeding Season. The anatomy was discussed by Call (1887, Proc. U. S. Natl. Mus. **10:** 499) and by Ortmann (1918, Nautilus **32:** 15), on the basis of which, the latter placed *U. breviculus* under *Lampsilis*. A glochidium was figured by Surber (1915, pl. 1, fig. 14) as *L. b. brittsi*, 0.23 × 0.29. Breeding season not recorded.

Habitat. Found by Call in shallow mountain streams, "being swift and limpid, with rocky bottoms."

Remarks. Villosa reeviana (Lea), as pointed out by Call, does not much resemble any other Ozarkian species. There is some variation within the several populations as to the thickness of the shell, width of the rays and degree of sexual dimorphism in the female. The male shell of *V. reeviana* has been confused with specimens of *V. vibex* (Conrad). The latter has a consistently thinner shell, broader green rays, and the female differs from the male only in that the posterior end of the shell is more broadly rounded, the post-basal margin is not truncated. The specimens mentioned by Frierson (1927: 74) from Onion Creek, Travis Co., Texas MZUM 79921 are *vibex*.

Range. Found only in the Ozarkian Region: below the Ozark Crest in the White River system; and above it in the Meramec, Gasconade and Osage River systems.

Abundance. Taken in large numbers from several localities in the Meramec River system by the Harvard-Ohio State Museum Expedition in 1965.

Specimens Examined

White River System

White River Drainage. *Arkansas:* Main Fork White River, Elkins, Washington Co. (MCZ). *Missouri:* James River, Galena, Stone Co. (MCZ, MZUM); White River, Hollister and Forsyth (*both* MZUM), *both* Taney Co. *Arkansas:* White River, Cotter (MZUM) and Norfolk (MCZ), *both* Baxter Co.

Big Buffalo Fork Drainage. *Arkansas:* Big Buffalo Fork, near Gilbert, Searcy Co.; Big Buffalo River, Buffalo River State Park, Marion Co.; (*both* MZUM).

Current River Drainage. *Missouri:* Big Creek, Texas Co.; Jacks Fork; Current River between Eminence and Ellsinore; *both* Shannon Co.; Current River, Big Spring State Park, Carter Co.; Current River, 1 mi. SW Doniphan, Ripley Co.; Eleven Point River, Riverton, Oregon Co.; (*all* MCZ).

Black River Drainage. *Missouri:* Mill Creek, 1 mi. E Lesterville, Reynolds Co. (MZUM).

Spring River Drainage. *Arkansas:* Spring River, Salem, Fulton Co. (MCZ).

Meramec River System

Big River Drainage. *Missouri:* Cedar Creek (MZUM), Mineral Fork, *both* Washington Co.; Big River, Jefferson Co. (*both* Buchanan, 1977, p. 31).

Meramec River Drainage. *Missouri:* Huzzah Creek, Crawford Co. (MZUM); Meramec River, Dent Co.; Meramec River, Steelville, Crawford Co. (*both* MCZ); Meramec River, at Franklin and St. Lewis Co. line (Buchanan, 1977, p. 31).

Bourbeuse River Drainage: *Missouri:* Bourbeuse River, Franklin Co. (Buchanan, 1977, p. 31).

Gasconade River System

Gasconade River Drainage. *Missouri:* Big Piney River, 7 mi. W Licking, Texas Co.; Gasconade River, 6 mi. NW Vichy, Maries Co. (*both* MCZ).

Osage River System

Osage River Drainage. *Missouri:* Little Niangua River (MCZ, MZUM); Niangua River, Hahatonka (Utterback); *both* Camden Co.

Genus *Cyprogenia* Agassiz

Cyprogenia Agassiz 1852, Archiv für Naturgeschichte, **18** (1): 47. Type species, *Unio irroratus* Lea, original designation. Ortmann, 1912, Ann. Carnegie Mus. **8**: 312.

Cyprogenia aberti (Conrad)

Plate 19, figure 3
Plate 20, figures 1–4
Distribution: Plate 6

Unio aberti Conrad 1850, Proc. Acad. Nat. Sci. Phila. **5**: 10 (Rapids of Verdigris River, Chambers' Ford [not located, Oklahoma] Arkansas [River system]; 1854, Jour. Acad. Nat. Sci. Phila. (2) **2**: 295, pl. 26, fig. 1, figured type not located by Johnson and Baker, 1973, Proc. Acad. Nat. Sci. Phila. **125**: 147. Call, 1895, Trans. Acad. Sci. St. Louis **7**: 4.

Unio lamarckianus Lea 1852, Trans. Amer. Philos. Soc. **10**: 266, pl. 17, fig. 20 (Caddo River; Washita [Ouachita] River, near the Hot Springs, [Garland Co.]; *both* Arkansas; figured holotype USNM 84306, labeled, "White River, Arkansas."); 1852, Obs. Unio **5**: 22.

Unio popenoi Call 1885, Bull. Washburn College Lab. Nat. Hist. **1**: 49, pl. 2 (Fall River, Wilson Co., figured holotype MCZ 4934; Verdigris River; *both* Kansas); is *Unio aberti* Conrad, *teste* Call, 1887, Amer. Nat. **21**: 860.

Cyprogenia aberti (Conrad). Scammon, 1906, Kansas Univ. Sci. Bull. **3**: 315, pl. 71, fig. 2. Simpson, 1914, Cat. Naiades **1**: 328. Utterback, 1916, Amer. Midl. Nat. **4**: 322 [134], pl. 25, figs. 83 A, B. Isely, 1925, Proc. Oklahoma Acad. Sci. **4**: 103. Murray and Leonard, 1962, Univ. Kansas, Mus. Nat. Hist., Pub. no. 28, p. 105, pl. 27, figs. 1–4, text fig. 23. Branson, 1966, Sterkiana no. 23, p. 7.

Cyprogenia aberti lamarckiana (Lea). Simpson, 1914, Cat. Naiades, **1**: 329. Utterback, 1916, Amer. Midl. Nat. **4**: 323 [135].

Unio irroratus Call. 1895, Trans. Acad. Sci. St. Louis **7**: 20, *non* Lea 1828.

Description. Shell of medium size, seldom exceeding 80 mm in length. Outline usually rhomboidal, occasionally rounded triangular. Valves slightly inflated, thick and heavy. Anterior end regularly rounded; posterior end subtruncate. Ventral margin more or less rounded, tending to be straight or slightly concave posteriorly. Dorsal margin slightly convex forming a more or less distinct angle with the almost vertical, sometimes concave, posterior margin. Hinge ligament rather long. Posterior ridge well developed, high and narrow at the umbonal region, becoming flattened and somewhat double, with a wide shallow groove before it. Posterior slope with a radial furrow, very narrow. Umbos low and compressed, curved forward over the lunule, located at the middle of the shell or somewhat anteriorly. Surface of the shell with strong, low, more or less numerous, concentric ridges; in addition it is sometimes subvertically wrinkled and nodulous. Periostracum scarcely shining, yellowish green, with dots and flecks of dark green which fall into broad broken rays. Hinge very broad and flat. Left valve with two heavy, triangular, blunt and ragged, pseudocardinal teeth of about equal height; also with two short, very low lateral teeth. Right valve with one large pseudocardinal, sometimes with a feeble one on each side of it. Interdentum is very broad. One low double or triple lateral tooth. Umbonal cavities are very shallow and compressed. Anterior and posterior adductor muscle scars and pallial line are all well impressed. Nacre is white, thinner and somewhat iridescent anteriorly.

Length mm	Height mm	Width mm	
80	75	44	Fall River, Wilson Co., Kansas. Paratype of *Unio popenoi*.
48	41	26	Ouachita River, Arkadelphia, Clark Co., Arkansas.

Anatomy and Breeding Season. Unknown.

Habitat. Reported from Kansas as living in rocky, gravel or soft mud substrates (Murray and Leonard, 1962: 107).

Remarks. Cyprogenia aberti (Conrad) of the Ozarkian Region is readily distinguishable from all other unionids there by the peculiar, mottled color of the periostracum; its generally compressed, oval or rhomboidal shell; and by the subvertical wrinkles or nodules which occur at least on the upper part of the disk. While most specimens of *aberti* are oval or rhomboidal, some specimens become

rounded triangular, much resembling *C. stegaria* of the Cumberlandian and Ohioan regions. Call (1895: 20) in a collection made in the St. Francis River, Wittsburg, Cross Co., Arkansas, noted that many of the young appeared to be *aberti*, but that, "the triangular outline is lost with age and the circular form becomes more and more marked." This lot, MCZ 5492, now consists of only two adult specimens. He also mentioned specimens from the Saline River of the Black River system, now lost. He regarded both of these lots as being *irroratus* = *stegaria*. Frierson (1927: 66) mentioned that *stegaria* and *aberti* "almost merge into one unbroken chain in the state of Arkansas." Having studied virtually all of the available material, it is admitted that occasional specimens of both *aberti* and *stegaria* closely resemble one another, but the shell of the former species always has a much narrower, and more compressed posterior slope.

Range. Found only in the Ozarkian Region: below the Ozark Crest in the Black, Arkansas, White, and St. Francis river systems; and above it in the Meramec River system.

Abundance. Formerly abundant in the Fall River, Kansas. Murray and Leonard (1962: 107) claimed that this species has not been collected in Kansas since 1906. Collected in some numbers by the Harvard-Ohio State Museum Expedition, 1965, in the Ouachita River, of the Black River system, near Pencil Bluff, Montgomery Co., Arkansas.

Specimens Examined

Ozarkian Region

Black River System

Ouachita River Drainage. *Arkansas:* Ouachita River, 3 mi. SE Pencil Bluff, Montgomery Co. (MCZ); Ouachita River, nr. Hot Springs, Garland Co. (Lea); Ouachita River, N Cove Creek, Hot Springs Co. (CM); Caddo Creek (USNM); Ouachita River, Arkadelphia, Clark Co. (MCZ).

Saline River Drainage. *Arkansas:* Saline River, Benton, Saline Co. (MCZ).

Arkansas River System

Verdigris River Drainage. *Kansas:* Fall River, 3.5 mi. S Fredonia, Wilson Co. (MZUM); Verdigris River (MCZ). *Oklahoma:* Verdigris River, Oologa (USNM), Catoosa, NW Inola (*both* Isely), *all* Rogers Co. Verdigris River, Chambers Ford [not located] (Conrad).

Neosho River Drainage. *Kansas:* Neosho River, Lyon Co. (Murray and Leonard); Spring River, 2 mi. E Pittsburg (Branson).

White River System

White River Drainage. *Arkansas:* White River, Elkins, Washington Co. (MCZ). *Missouri:* White River, Hollister (Utterback), Forsyth (MZUM), *both* Taney Co. *Arkansas:* White River, Cotter, Norfork (*both* MCZ), *both* Baxter Co.

Big Buffalo Fork Drainage. *Arkansas:* Big Buffalo Fork, Newton Co. (Meek and Clark); Big Buffalo Fork, 2.5 mi. below Red Cloud Mine, Marion Co. (MZUM, from Meek and Clark, Station 25).

Little Red River Drainage. *Arkansas:* Little Red River, Clinton, Van Buren Co. (MCZ).

Black River Drainage. *Missouri:* Black River, .5 mi. W Hendrickson (MCZ), Poplar Bluff (MZUM), *both* Butler Co. *Arkansas:* Black River, Pocahontas, Randolph Co. (MCZ).

Spring River Drainage. *Arkansas:* South Fork Spring River nr. Salem, Fulton Co. (MZUM); Spring River, Hardy, Sharp Co.; Spring River, Black Rock, Lawrence Co. (*both* MCZ).

St. Francis River System

St. Francis River Drainage. *Missouri:* Little St. Francis River, 9 mi. E Ironton, Madison Co. (MZUM); St. Francis River, Greenville, Wayne Co. (MZUM); St.

sas: Tyronza River, Tyronza, Poinsett Co. (MZUM); St. Francis River, Wittsburg, Cross Co. (MCZ).

MERAMEC RIVER SYSTEM

Meramec River Drainage. *Missouri:* Meramec River, Crawford Co. (see Plate 20 fig. 4)

Cyprogenia stegaria (Rafinesque)

Plate 18, figures 1, 2
Plate 19, figures 1, 2
Distribution: Plate 6

Obovaria stegaria Rafinesque 1820, Ann. Gén. Sci. Physiques, Bruxelles **5:** 308 (l'Ohio [River]; lectotype ANSP 20215, selected by Johnson and Baker, 1973, Proc. Acad. Nat. Sci. Phila. **125:** 173, pl. 4, fig. 3).

Unio verrucosus albus Hildreth 1828, Amer. Jour. Sci. **14:** 281 (Muskingum [River, near Marietta, Washington Co., Ohio]; type [lost]).

Unio irroratus Lea 1828, Trans. Amer. Philos. Soc. **3:** 269, pl. 5, fig. 5 (Ohio; figured holotype USNM 84637 [lost]. Reeve, 1864, Conch. Iconica **16:** *Unio*, pl. 12, species 44).

Cyprogenia irrorata pusilla Simpson 1900, Proc. U. S. Natl. Mus. **22:** 610 (Green River [Mammoth Cave, Edmonson Co.] Kentucky; lectotype USNM 152004, selected by Johnson, 1975, Special Occ. Pub., Dept. Moll., Mus. Comp. Zool. no. 4: 17; pl. 2, fig. 2).

Unio stegarius (Rafinesque). Say, 1834, Amer. Conch. no. 6 [no pagination] *Unio irroratus* Lea is listed as a synonym. Conrad, 1838, Monography Unionidae of North America, no. 10, p. 83, pl. 46, fig. 1. Reeve, 1864, Conch. Iconica **16:** *Unio*, pl. 12, species 45.

Cyprogenia stegaria (Rafinesque). Ortmann, 1919, Mem. Carnegie Mus. **8:** 218, pl. 13, fig. 5. Frierson, 1927, Check list N American naiades, p. 66.

Cyprogenia irrorata (Lea). Simpson, 1900, Proc. U. S. Nat. Mus. **22:** 610. Ortmann, 1912, Ann. Carnegie Mus. **8:** 312, fig. 17. Simpson, 1914, Cat. Naiades **1:** 327. Ortmann and Walker, 1922, Occ. Papers, Mus. Zool., Univ. Michigan no. 112, p. 43. La Rocque, 1967, Geol. Surv. Ohio, Bull. No. 62 (2): 232, figs. 118, 119. Parmalee, 1967, Illinois State Mus., Popular Sci. Ser. **8:** 61, pl. 20: A, Frontispiece.

Description. Shell of medium size, seldom exceeding 80 mm in length. Outline subcircular, subtrapezoidal, or rounded triangular. Valves somewhat inflated, thick and heavy. Anterior end broadly rounded; posterior end subtruncate. Ventral margin more or less rounded, tending to be straight or slightly concave posteriorly. Dorsal margin slightly convex, forming an angle with the almost vertical posterior margin. Hinge ligament rather long. Posterior ridge well developed, high and narrowly rounded at the umbonal region; with a radial groove anterior to it and another shallower one posterior to it. Posterior slope slightly concave or flattened, rather broad. Umbos moderately high and full, but flattened, curved forward over the lunule, their sculpture consisting of a few slightly double-looped bars, located at the middle of the shell or somewhat anteriorly. Surface of the shell with strong, low, more or less numerous concentric ridges, The anterior end may be smooth, but there are usually nodules elsewhere where they assume a radial pattern. The nodules may be missing in older specimens. Periostracum light green or yellow, to light brown, ornamented with green mottlings, which fall into fine or broad green rays.

Hinge well developed. Left valve with two heavy, triangular, blunt and ragged, pseudocardinal teeth of about equal height, two short heavy lateral ones. Right valve with one large pseudocardinal. Interdentum very broad and short. One strong double lateral tooth. Umbonal cavities shallow, and compressed. Anterior and posterior adductor muscle scars and pallial line all well impressed. Nacre silvery white, seldom bluish or pinkish.

Length mm	Height mm	Width mm	
64	64	44	Tuscarawas River, New Philadelphia, Tuscarawas Co., Ohio.
49	49	35	Clinch River, Clinton, Anderson Co., Tennessee.

Anatomy and Breeding Season. Ortmann (1919: 219) discussed the several anatomical descriptions. A glochidium was figured by Ortmann (1912: pl. 19, fig. 6) and by Surber (1912: pl. 1, fig. 11). Ac-

cording to Ortmann it measured 0.18 × 0.15. He also (1919: 219) indicated that this species is bradytictic.

Habitat. Found in firmly packed gravel, in strongly flowing water in the Clinch and Holston rivers and in mussel beds on gravelly bottoms with steady currents in the deep channel of the Ohio River between Cincinnati and Pittsburgh (Ortmann, 1919: 220).

Remarks. In the Cumberlandian and Ohioan regions, *Cyprogenia stegaria* (Rafinesque) is distinguishable from all other unionids by the peculiar, mottled character of the color of the periostracum, and by its generally subglobular shape and nodular surface, although the shape and development of the nodules is variable. Occasional specimens resemble *C. aberti* (Conrad) of the Ozarkian Region (see Remarks under this section).

Specimens from the Cumberlandian Region are, in general, not as large as those from the Ohioan Region. *C. stegaria* appears to have found a more favorable environment in the Ohioan Region in post-glacial time, as apparently did *Plagiola flexuosa* (Rafinesque) (Johnson 1978: 284).

As indicated in the synonymy, Rafinesque's name for this species has been used by Say, Conrad, Ortmann, Frierson and others. Ortmann and Walker (1922: 43) argued that this species could not be identified from Rafinesque's description alone. Frierson (1927: 66) indicated that it could be so identified. The present *Rules of International Nomenclature* (1964) emphasize the identification of the type, so Rafinesque's name is clearly available.

Range. Cumberlandian Region: Tennessee and Cumberland river systems. Ohioan Region: Ohio River and its tributaries.

Abundance. This species appears to be locally abundant.

Specimens Examined

Cumberlandian Region

Tennessee River System

Clinch River Drainage. *Virginia:* Clinch River, Clinchport, above mouth of Copper Creek, 1.5 mi. below Speers Ferry bridge, *all* Scott Co.; Clinch River, 1.5 mi. S Dona, Lee Co. (*all* MCZ). *Tennessee:* Clinch River, below Kyles Ford bridge, Hancock Co. (MCZ); Clinch River, Clinch River Station, Claiborne Co. (CM); Clinch River, 4 mi. NW Thorn Hill, Grainger Co.; Clinch River, Clinton and Edgemoor, *both* Anderson Co.; Clinch River, 3 mi. S Wheat, Roane Co. (*all* MCZ).

Holston River Drainage. *Tennessee:* Holston River, Turley Mill, Grainger Co. (CM); Holston River, Mascot and near Knoxville, *both* Knox Co. (*both* MCZ).

Tennessee River Drainage. *Tennessee:* Tennessee River, Knoxville, Knox Co. (MCZ); Tennessee River, Rathburn, Hamilton Co. (MZUM). *Alabama:* Tennessee River, Bridgeport, Jackson Co. (MCZ).

Flint River Drainage. *Alabama:* Flint River [Madison Co.] (MZUM).

Tennessee River Drainage. *Alabama:* Tennessee River, Florence, Lauderdale Co.; Tennessee River, Tuscumbia, Colbert Co. (*both* MCZ); Pickwick Basin, mounds between Barton, Colbert Co. and Waterloo, Lauderdale Co. (Morrison).

Duck River Drainage. *Tennessee:* Duck River, Columbia, Maury Co. (Hinkley and Marsh, single specimen).

Cumberland River System

Cumberland River Drainage. *Kentucky:* Cumberland River, below Wolf Creek Dam, Russell Co. (MCZ); Cumberland River, Albany Landing; Cloyds Landing; *both* Cumberland Co.; (*both* CM).

Obey River Drainage. *Tennessee:* Obey River, Duncan Ford, 4 mi. SE Lilydale, Pickett Co. (MCZ).

Cumberland River Drainage. *Tennessee:* Cumberland River, Goodall Island, Smith Co. (Wilson and Clark); Cumber-

Francis River, Butler Co. (MCZ). *Arkan-*land River, Nashville, Davidson Co. (MCZ).

Ohioan Region

Ohio River System

Wabash River Drainage. *Indiana:* Wabash River, New Harmony, Posey Co.; Wabash River, Mt. Carmel, Wabash Co.; Wabash River, Terre Haute, Vigo Co.; Wabash River, Lafayette, Tippecanoe Co.; Wabash River, Delphi, Carroll Co.; Wabash River, Tippecanoe River, *both* White Co.; (*all* MCZ).

White River Drainage. *Indiana:* White River (MCZ).

Green River Drainage. *Kentucky:* Green River, Rio, and Munfordville, *both* Hart Co. (*both* MCZ); Green River, Mammoth Cave (MCZ); Onyx Cave (CM); *both* Edmonson Co.; Barren River, Bowling Green, Warren Co.; Green River, below dam at Rochester, Muhlenberg Co. (*both* MCZ).

Salt River Drainage. *Kentucky:* Rolling Fork, Salt River, .5 mi. S New Haven, Nelson Co. (MCZ).

Kentucky River Drainage. *Kentucky:* Kentucky River (Danglade).

Licking River Drainage. *Kentucky:* Licking River, Butler, Pendleton Co. (MCZ).

Ohio River Drainage. *Ohio:* Great Miami River (Sterki); Ohio River, Cincinnati, Hamilton Co. (MCZ); Little Miami River, Xenia, Green Co. (CM); Scioto River (MCZ); Ohio River, Portsmouth, Scioto Co. (CM): *Virginia:* Big Sandy River (MCZ). *Ohio:* Ohio River, Portland, Meigs Co. (CM). *West Virginia:* Ohio River, Parkersburg, Wood Co. (CM).

Muskingum River Drainage. *Ohio:* Muskingum River, Lowell, Washington Co.; Tuscarawas River, New Philadelphia, Tuscarawas Co.; (*both* MCZ).

Ohio River Drainage. *West Virginia:* Ohio River, St. Marys, Pleasants Co. (CM); Ohio River, Clarington, Monroe Co. (MCZ). *Pennsylvania:* Ohio River, Industry, Beaver Co. (CM).

Big Beaver River Drainage. *Ohio:* Mahoning River (Sterki).

Allegheny River Drainage. *Pennsylvania:* Allegheny River, Godfrey and Alladin, *both* Armstrong Co. (*both* CM); Allegheny River, Natrona, Allegheny Co. (CM).

Monongahela River Drainage. *Pennsylvania:* [Monongahela River] Indian kitchen-midden opposite Point Marion, Fayette Co. (CM).

Genus *Ptychobranchus* Simpson

Ptychobranchus Simpson 1900, Proc. Acad. Nat. Sci. Phila. **52:** 79. Type species, *Unio phaseolus* Hildreth, original designation. Ortmann, 1912, Ann. Carnegie Mus. **8:** 305.

Subtentus Frierson 1927, Check list N American naiades, pp. 10, 65. Type species, *Unio subtentus* Say, original designation. Frierson created this monotypic subgenus for *P. subtentum* (Say), a Cumberlandian species, probably because of the corrugations on its posterior slope. Its use seems unnecessary in a genus consisting of 4 species. In addition to *P. subtentum*; there is *fasciolare* (Rafinesque) from the Cumberland and Ohioan Regions; *occidentalis* (Conrad) from the Ozarkian Region; and *greeni* (Conrad) which is restricted to the Mobile-Alabama-Coosa River system.

Ptychobranchus occidentalis (Conrad)
Plate 20, figures 5, 6
Distribution: Plate 7 A

Unio occidentalis Conrad 1836, Monography Unionidae, no. 7, p. 64, pl. 36, fig. 1 (Current River [Randolph Co.], Arkansas, figured type not located, *teste*, Johnson and Baker, 1973, Proc. Acad. Nat. Sci. Phila. **125:** 163).

Ptychobranchus clintonensis Simpson 1900, Proc. Acad. Nat. Sci. Phila. **52:** 79, pl. 5, fig. 3 (Archies Fork of Little Red River, near Clinton [Van Buren Co.], Arkansas; holotype USNM 124615); 1900, Proc. U. S. Natl. Mus. **22:** 613; 1914, Cat. Naiades **1:** 335. Isely, 1925, Proc. Oklahoma Acad. Sci. **4:** 102.

Ellipsaria clintonensis (Simpson). Utterback, 1916, Amer. Midl. Nat. **4:** 316 [128], pl. 25, figs. 81 A, B.

Ptychobranchus occidentalis (Conrad). Valentine and Stansbery 1971, Sterkiana, no. 42, p. 23.

Ptychobranchus phaseolus Scammon. 1906, Univ. Kansas Sci. Bull. **3:** 319, pl. 72, fig. 2. Isely, 1925, Proc. Oklahoma Acad. Sci. **4:** 102; *non* Hildreth 1828.

Ptychobranchus fasciolare Murray and Leonard. 1962, Univ. Kansas, Mus. Nat. Hist., Pub. no. 28, p. 162, pl. 45, fig. 1, *non* Rafinesque 1820.

Description. Shell medium to large, occasionally exceeding 100 mm in length. Outline oblong, ovate, elliptical or subrhomboid, sometimes subtriangular. Valves subinflated, very solid. Anterior end regularly rounded. Posterior end more broadly rounded. Ventral margin straight or slightly curved. Dorsal margin curved imperceptably joining the obliquely descending posterior margin. Hinge ligament long. Posterior ridge usually indistinct, rounded, often somewhat double, ending in a slight biangulation near the base. Umbos not inflated, or much raised above the hinge line, their sculpture not seen, located considerably forward of the middle of the shell. Surface of the shell smooth. Periostracum yellowish-green, brownish, with very delicate, wavy, continuous green rays, often over the entire surface.

Left valve with two low, small, solid, pseudocardinal teeth, and two low lateral teeth. Right valve with one large tooth directly under the umbo, with a vestigial one on either side of it. Interdentum short but very wide. One lateral tooth which is sometimes more or less double. Umbonal cavities very shallow; anterior and posterior muscle scars well impressed. Pallial line impressed anteriorly. Nacre bluish white, often with lurid blotches.

Length mm	Height mm	Width mm	
116	67	40	Verdigris River, Neodesha, Wilson Co., Kansas.
91	45	27	Archies Fork, of Little Red River, nr. Clinton, Van Buren Co., Arkansas. Paratype of *P. clintonensis* MCZ 192371.

Anatomy and Breeding Season. Discussed in part under *P. phaseolus* (Hildreth), by Ortmann (1912: 306). *P. occidentalis* is bradytictic.

Remarks. Ptychobranchus occidentalis (Conrad) is restricted to the Ozarkian Region. It is most closely related to *P. fasciolare* (Rafinesque) of the Cumberlandian and Ohioan regions. Valentine and Stansbery (1971: 23) claimed to have specimens of *fasciolare* from Missouri, and while their specimens were not examined, all other specimens studied from Missouri proved to be *occidentalis*. While *occidentalis* and *fasciolare* are very similar, most of the rays on the shell of the former are always very fine, uniform, and generally continuous, while those of the latter are always wide, and often broken into spots.

In the Ozarkian Region *occidentalis* has been confused with *Elliptio dilatata* (Rafinesque). It does not much resemble the latter which has a longer, less high shell, often with an arcuate ventral margin. It is seldom rayed, and usually has a violet nacre.

Range. Found only in the Ozarkian Region: below the Ozark Crest in the Red, Black, Arkansas, White, and St. Francis river systems; and above it in the Meramec River system.

Abundance. The size of the lots examined tend to indicate this species is rather abundant.

Specimens Examined

Red River System

Blue River Drainage. *Oklahoma:* Blue River, Milburn, Johnson Co.; Blue River, Durant, Bryan Co.; (*both* Valentine and Stansbery, 1971: 23).

Kiamichi River Drainage. *Oklahoma:* Kiamichi River, Tuskahoma, Pushmataka Co. (MZUM).

Little River Drainage. *Oklahoma:* Glover Creek, Glover, McCurtain Co. (MCZ). *Arkansas:* Cossatot River, 5.5 mi. ESE Gillham; Rolling Fork River, S Gillham; *both* Sevier Co. (*both* MCZ).

Black River System

Ouachita River Drainage. *Arkansas:* Ouachita River, 3 mi. SE Pencil Bluff, Montgomery Co.; Ouachita River, Arkadelphia, Clark Co. (*both* MCZ); Ouachita River, Camden, Ouachita Co. (MZUM).

Caddo Creek Drainage. *Arkansas:*

Caddo Creek, Caddo Gap, Montgomery Co.; Caddo Creek, 4 mi. above mouth, Caddo Valley, Clark Co.; (*both* MCZ).

Saline River Drainage. *Arkansas:* Saline River, Benton, Saline Co.; Saline River, Jenkins Ferry, Grant Co.; (*both* MZUM).

Arkansas River System

Verdigris River Drainage. *Kansas:* Fall River, Elk Co.; Verdigris River, Neodesha, Wilson Co.; (*both* MCZ).

Neosho River Drainage. *Kansas:* Neosho River, Iola, Allen Co. (MCZ, MZUM). *Missouri:* Spring River, Carthage (MCZ) and Webb City (Utterback); *both* Jasper Co. *Kansas:* Spring River, Cherokee Co. (Branson, 1966, Nautilus **80:** 22).

White River System

White River Drainage. *Arkansas:* White River, Sulphur City and N Elkins (*both* MZUM), *both* Washington Co. *Missouri:* James River, Galena, Stone Co. (MCZ); White River, Hollister (Utterback), Forsyth (MZUM); *both* Taney Co. *Arkansas:* White River, Cotter (MCZ) and Norfolk (MZUM), *both* Baxter Co.; Archie's Fork, Little Red River, near Clinton, Van Buren Co. (MCZ).

Black River Drainage. *Missouri:* Black River, Poplar Bluff, Butler Co. (MCZ).

Spring River Drainage. *Arkansas:* South Fork Spring River, near Salem, Fulton Co.; Spring River, Hardy and Willford; *both* Sharp Co.; Spring River, Black Rock, Lawrence Co.; (*all* MZUM).

Current River Drainage. *Missouri:* Big Creek, Texas Co. (MCZ, MZUM); Jacks Fork, Shannon Co. (Utterback); Current River, Big Spring State Park, Carter Co. (MZUM); Current River, 1 mi SW Doniphan, Ripley Co. (MCZ).

St. Francis River System

Little St. Francis River Drainage. *Missouri:* Little St. Francis River, 9 mi. E Ironton, Madison Co. (MZUM).

Meramec River System

Big River Drainage. *Missouri:* Mineral Fork, Washington Co. (Buchanan, 1977, fig. 48).

Meramec River Drainage. *Missouri:* Meramec River, Meramec State Park, Franklin Co. (MCZ).

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Plate 1.

The drainages of North America relevant to the post-glacial distribution of Unionacea.

Maximum Nebraskan glaciation is regarded as extending, roughly, to the present Missouri and Ohio rivers.

Wisconsin glaciation is marked by a double dotted line (After Flint, 1971, Fig. 21.1). No attention is paid to the several driftless areas since they do not have any bearing on unionid distribution.

The regions, systems, and drainages are marked by white letters in black circles.

A. Ozarkian Region. Consists of the Osage, Gasconade, and Meramec river systems above the Ozark Crest, and below it the St. Francis, White, Arkansas, Black and Red river systems. The latter two are not included on this map, but they appear on the distributional maps.
B. Cumberlandian Region
C. Mississippian Region
D. Ohioan Region
E. Northern Atlantic Slope Region
F. St. Lawrence River System (partial)

CANADIAN INTERIOR BASIN Insert from Clarke 1973, inside of front cover in some copies.

G. Pacific Coastal Region
H. Arctic Drainage
I. Hudson Bay Drainage
J. St. Lawrence River system (continued)

Areas of former confluences are marked by letters in white circles.

A. Area of confluence between the Minnesota and Red rivers.
B. Confluence of the Fox and Wisconsin rivers in the vicinity of Portage, Columbia Co., Wisconsin. Dotted lines in Lake Michigan indicate the now submerged Mackinac River system of which the Millecoquin River, in the eastern part of the Upper Michigan Peninsula, and the Carp and Ocqueoc, in the northern part of the Lower Peninsula, were once part.
C. Area of confluence of the Des Plaines River which, by way of the Chicago outlet, drained into the Illinois River. Before the formation of Lake Michigan, the Muskegon, Grand, and St. Joseph rivers of western Michigan connected with the Des Plaines River. The Muskegon River was tributary to the Grand, and these had a confluence with the Saginaw River.
D. Confluence of the Wabash and Maumee rivers in the vicinity of Fort Wayne, Allen Co., Indiana. During the Trent Stage, the Maumee flowed through the partially dry bed of Lake Erie into the Wabash. Many of the rivers presently flowing into Lake Erie were once part of the Greater Maumee drainage. Among these are the Clinton River which flows into Lake St. Clair; the Huron and Raisin rivers in eastern Michigan; the Sandusky, Vermilion, lower Cuyahoga, and Grand Rivers in Ohio; as well as the Grand River in Ontario. The Rouge River between the Clinton and Huron rivers was of later origin and was never connected to the Greater Maumee drainage.
E. Area of confluence of Lake Newberry, which inundated the Finger Lakes Basin and flowed south into the Susquehanna River.
F. Area of confluence between the Finger Lakes Basin and the Mohawk River.

Principal rivers and features mentioned in the tables and text which are not clearly visible on the map:

1. Ozark Crest
2. Black Water River
3. Meramec River
4. Monongahela River
5. Allegheny River
6. Tradewater River
7. Salt River
8. Ottawa River

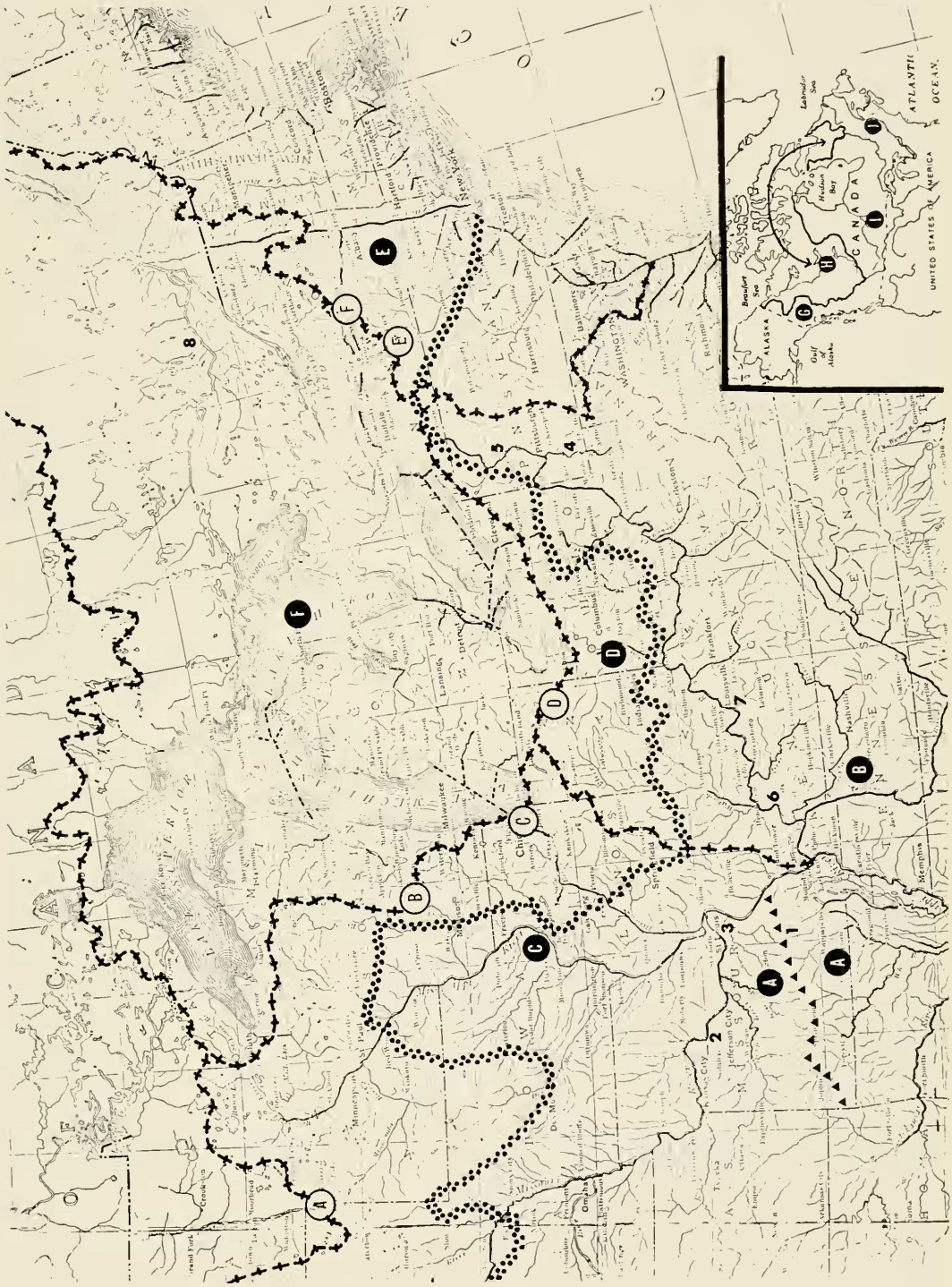

CANADA
UNITED STATES OF AMERICA
ATLANTIC OCEAN
Hudson Bay
Labrador Sea
Beaufort Sea
Gulf of Alaska
ALASKA
A
B
C
D
E
F
G
H
I
1
2
3
4
5
6
7
8

Plate 2.

The distribution of *Lampsilis abrupta* (Say) (squares), and *Lampsilis higginsi* (Lea) (dots). Triangles represent localities from which both species have been reported.

The distribution of these two closely related species suggests that *L. abrupta* had well established Pleistocene refugia in the Tennessee and Cumberland rivers, and probably also in the Monongahela and Allegheny rivers. It is the only Cumberlandian species to be found in the Mississippian region. While the Ozarkian species *L. higginsi* is found on both sides of the Ozark Crest, it is probable that the Meramec River drainage population was the Pleistocene refugium of the present Mississippian and Ohioan populations.

It appears that *L. abrupta* reached eastern Lake Erie during the Trent Stage, when the Maumee River flowed through the partially dry bed of Lake Erie into the Wabash as did *Proptera capax*, Plate 3.


Minneapolis
St. Paul
Red Wing
Winona
La Crosse
Dubuque
Fort Madison
Keokuk
Hannibal
Moberly
Louisiana
St. Charles
St. Louis
Alton
Belleville
Grand Tower
Cairo
Memphis
Chicago
Aurora
Joliet
Ottawa
Peoria
Galesburg
Rock Island
Davenport
Muscatine
Burlington
Quincy
Keokuk
Waterloo
Cedar Rapids
Des Moines
Council Bluffs
Omaha
Sioux City
Kansas City
Jefferson City
Sedalia
Lawrence
Topeka
Atchison
Leavenworth
Emporia
Paola
Fort Gibson
Muskogee
Tulsa
Fort Smith
Little Rock
Hot Springs
Pine Bluff
Arkansas City
Winfield
Independence
Coffeyville
Joplin
Springfield
Fayetteville
Batesville
Jonesboro
Helena
Greenville
Vicksburg
Natchez
Yazoo City
Jackson
Meridian
Columbus
Tuscaloosa
Selma
Montgomery
Eufaula
Tuskegee
Opelika
Auburn
Columbus
Atlanta
Griffin
Macon
Milledgeville
Augusta
Athens
Gainesville
Greenville
Spartanburg
Greenwood
Anderson
Abbeville
Columbia
Orangeburg
Charleston
Florence
Wilmington
Fayetteville
Goldsboro
Raleigh
Durham
Greensboro
Salisbury
Statesville
Winston Salem
Concord
Charlotte
Gastonia
Rutherfordton
Asheville
Morristown
Bristol
Kingsport
Johnson City
Elizabethton
Knoxville
Oak Ridge
Harriman
Chattanooga
Cleveland
Dalton
Rome
Gadsden
Anniston
Talladega
Birmingham
Tuscumbia
Florence
Sheffield
Huntsville
Decatur
Athens
Pulaski
Columbia
Shelbyville
Murfreesboro
Lebanon
Gallatin
Springfield
Clarksville
Nashville
Hopkinsville
Bowling Green
Elizabethtown
Owensboro
Henderson
Evansville
New Harmony
Princeton
Vincennes
Terre Haute
Lafayette
Logansport
Kokomo
Muncie
Anderson
Indianapolis
Richmond
Connersville
Lawrenceburg
Madison
New Albany
Jeffersonville
Louisville
Frankfort
Lexington
Paris
Maysville
Cincinnati
Hamilton
Middletown
Dayton
Springfield
Xenia
Columbus
Newark
Zanesville
Cambridge
Marietta
Parkersburg
Point Pleasant
Huntington
Ashland
Ironton
Portsmouth
Chillicothe
Athens
Pomeroy
Middleport
Gallipolis
Ripley
Maysville
Portsmouth
Steubenville
Wheeling
Weirton
Wellsburg
Follansbee
Pittsburgh
Beaver
Sewickley
Monongahela
Washington
Uniontown
Connellsville
Greensburg
Latrobe
Johnstown
Altoona
Huntingdon
Lewistown
Harrisburg
Carlisle
Chambersburg
Hagerstown
Cumberland
Frostburg
Oakland
Grafton
Fairmont
Clarksburg
Weston
Buckhannon
Elkins
Parkersburg
Charleston
Point Pleasant
Huntington
Ashland
Ironton
Portsmouth
Chillicothe
Athens
Pomeroy
Middleport
Gallipolis
Ripley
Maysville
Portsmouth
Steubenville
Wheeling
Weirton
Wellsburg
Follansbee
Pittsburgh
Beaver
Sewickley
Monongahela
Washington
Uniontown
Connellsville
Greensburg
Latrobe
Johnstown
Altoona
Huntingdon
Lewistown
Harrisburg
Carlisle
Chambersburg
Hagerstown
Cumberland
Frostburg
Oakland
Grafton
Fairmont
Clarksburg
Weston
Buckhannon
Elkins

Plate 3.

The distribution of *Proptera capax* (Green). This species appears to have had Pleistocene refugia in the Ozarkian Region, but only below the Ozark Crest. It is presumed that *capax* reached eastern Lake Erie, and at least one tributary of western Lake Ontario, during the Trent Stage, when the Maumee River flowed through the partially dry bed of Lake Erie into the Wabash.


Minneapolis
St. Paul
Stillwater
Eau Claire
WISCONSIN
Red Wing
Mankato
Winona
La Crosse
Madison
Milwaukee
Green Bay
Appleton
Manitowoc
Sheboygan
Grand Pt. Sable
Manistee
Little Pt. Sable
Muskegon
Bay City
Saginaw
Fort Huron
Lansing
Detroit
Toledo
Cleveland
Erie
Buffalo
Niagara Falls
Janesville
Kenosha
Racine
Kalamazoo
Jackson
Waterloo
Cedar Rapids
Dubuque
Freeport
Rockford
Elgin
Chicago
Aurora
Joliet
South Bend
Laporte
Fort Wayne
Sandusky
Lorain
Youngstown
Canton
Pittsburg
Des Moines
Davenport
Rock Island
Muscatine
Ottumwa
Burlington
Fort Madison
Galesburg
Peoria
Bloomington
Kankakee
Salle
Ottawa
Lafayette
Logansport
Mansfield
Stephenville
Wheeling
Zanesville
Fairmont
Grafton
Clarksburg
Parkersburg
Athens
Columbus
Newark
Delaware
Springfield
Dayton
Richmond
Indianapolis
Terre Haute
Danville
Decatur
Springfield
Jacksonville
Quincy
Keokuk
Hannibal
St. Joseph
Moberly
Louisiana
Kansas City
Sedalia
St Charles
St Louis
Alton
Belleville
Jefferson City
Arlington
Warsaw
Vincennes
Jeffersonville
New Albany
Louisville
Frankfort
Lexington
Winchester
Cincinnati
Newport
Hamilton
Middletown
Portsmouth
Ironton
Ashland
Huntington
Charleston
Evansville
Owensboro
Lebanon
Roanoke
Grand Tower
Rosiclare
Cairo
Paducah
Mound City
Bowling Green
Hopkinsville
Middlesboro
Bristol
Winston-Salem
Joplin
Springfield
Wappapello
Eureka
Dunnigan
Hickman
Clarksville
Nashville
Knoxville
Salisbury
Concord
Charlotte
Gastonia
Dragoon
Carutherville
Tyler
Jonesboro
Marfreesboro
Columbia
Jackson
Chattanooga
Spartanburg
Greenville
Fort Smith
Memphis
Florence
Huntsville
Gainesville
Rome
Columbia
Little Rock
Hot Springs
Pine Bluff
Helena
Fulton
Marietta
Atlanta
Athens
Augusta
Fulton
Camden
Aberdeen
Birmingham
Talladega
Bessemer
Tuscaloosa
Griffin
Lagrange
Macon
Milledgeville
ARKANSAS
TENNESSEE
MISSOURI
KENTUCKY
VIRGINIA
WEST VIRGINIA
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
Mississippi River
Ohio River
Tennessee River
Cumberland River
Wabash River
Illinois River
Missouri River
Kanawha River
Big Sandy River
Yazoo River
Tombigbee River
Alabama River
Coosa River
Chattahoochee River
Flint River
Ocmulgee River
Oconee River
Savannah River
Pearl River
Red River
Arkansas River
White River
Black River
St. Francis River
Obion River
Duck River
Elk River
Green River
Licking River
Kentucky River
Big Sandy River
Guyandotte River
Little Kanawha River
Monongahela River
Allegheny River
Muskingum River
Scioto River
Great Miami River
Maumee River
Wabash River
Kankakee River
Fox River
Rock River
Illinois River
Des Moines River
Iowa River
Cedar River
Wisconsin River
Fox River
Pecatonica River
Sugar River
Rock River
Grand River
Saginaw River
Au Sable River
Manistee River
Muskegon River
Grand River
Kalamazoo River
St. Joseph River
Maumee River
Sandusky River
Cuyahoga River
Grand River
Ashtabula
Erie
Niagara Falls
Buffalo
Lake Michigan
Lake Huron
Lake Erie
Lake Ontario

Plate 4.

The distribution of *Arcidens confragosus* (Say). The unconfirmed record from the St. Lawrence River System: Great Lakes Drainage (Lake Michigan). *Illinois:* Chicago, Cook Co. is represented by an open circle. Records from the James River Drainage, South Dakota, of the Missouri River System, are beyond the limits of the map.

This species is widely distributed in the Gulf Coastal Region and in tributaries of the Mississippi south of the Ozark Crest. It is possible that the Meramac River drainage was the Pleistocene refugium of the present Mississippian and Ohioan populations. It is assumed that the one record from the Tennessee River is the result of the recent introduction of fishes behind Kentucky Dam. If this is so, in all probability this species reached the Ohioan Region from the west in post-glacial time, though it may have had a refugium in the Green River Drainage.

It is not impossible that *A. confragosus* reached Lake Michigan when the rivers of western Michigan, i.e. the Grand, the Muskegon, and the Saginaw, connected with the Des Plaines River, through the Chicago outlet and Illinois River to the Mississippi. Nevertheless, this record could not be confirmed and since it has never been reported elsewhere in Lake Michigan, and since the open lake in the vicinity of Chicago does not appear to be a propitious environment for it, this record is regarded as spurious.

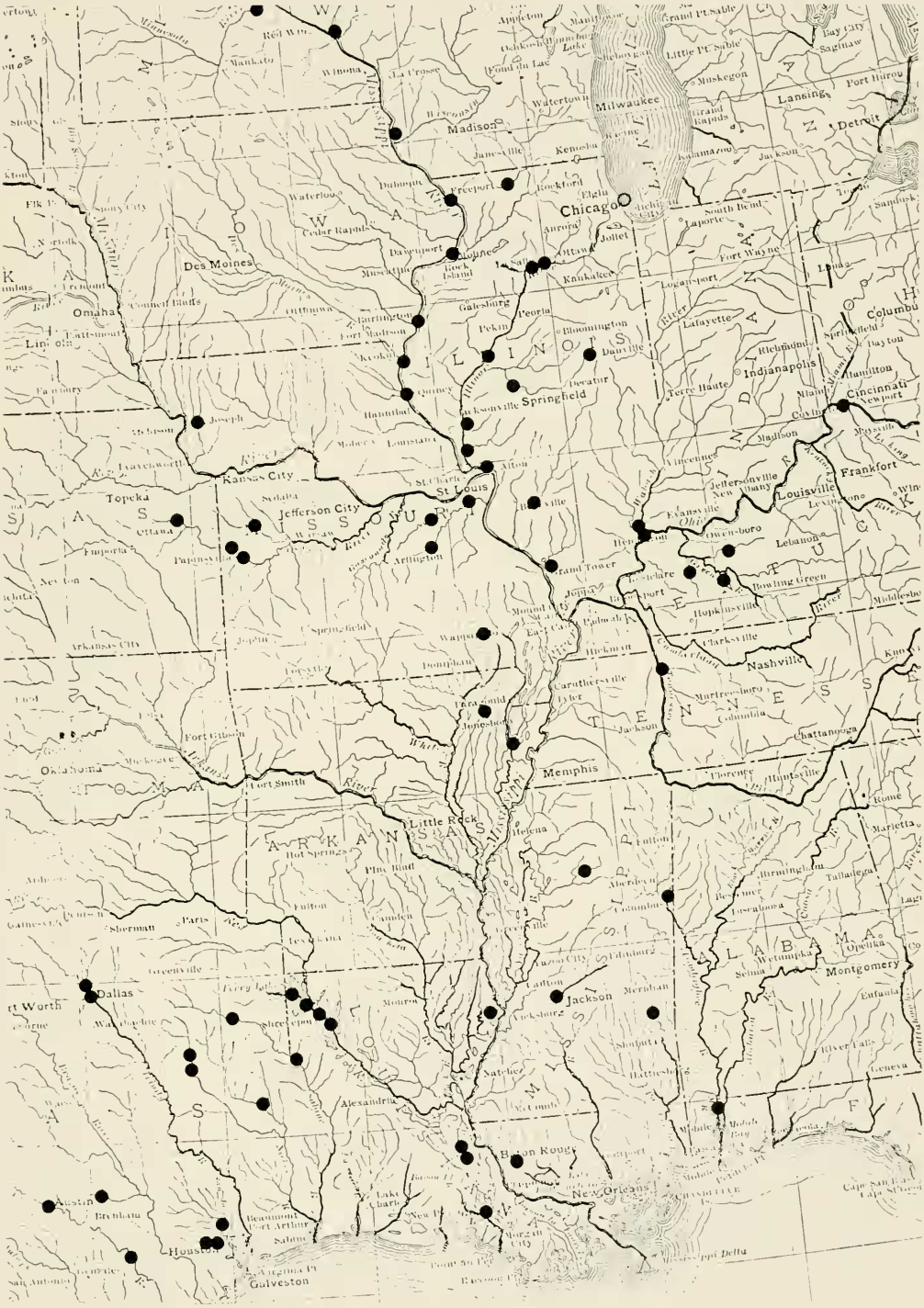

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Milwaukee
Madison
Springfield
Indianapolis
Cincinnati
Louisville
Frankfort
Nashville
Memphis
Little Rock
Jackson
Montgomery
Dallas
Houston
Galveston
New Orleans
Baton Rouge
Kansas City
St. Louis
Omaha
Des Moines
Topeka
Jefferson City
Detroit
Lansing
Columbus
Chattanooga
Birmingham
Mobile

Plate 5.

The distribution of *Anodonta suborbiculata* Say. Records from the Big Blue and Elkhorn river drainages, Nebraska, of the Missouri River System, are beyond the limits of the map.

The distribution of this species in the Gulf Coastal Region is discontinuous, as it is in the tributaries of the Mississippi, south of the Ozark Crest. It is impossible to isolate a single refugium for the present Mississippian and Ohioan populations. It is assumed that the one record from the Tennessee River is the result of the recent introduction of fishes behind Wheeler Dam. If this is so, then in all probability this species reached the Ohioan Region from the west in postglacial time, though it may have had a refugium in the Green River drainage.

Anodonta suborbiculata, like *A. corpulenta*, *Villosa lienosa*, *Ligumia subrostrata*, and *Uniomerus tetralasmus*, is a species which does not usually inhabit large rivers, but is more often found in smaller streams, sloughs or lakes.

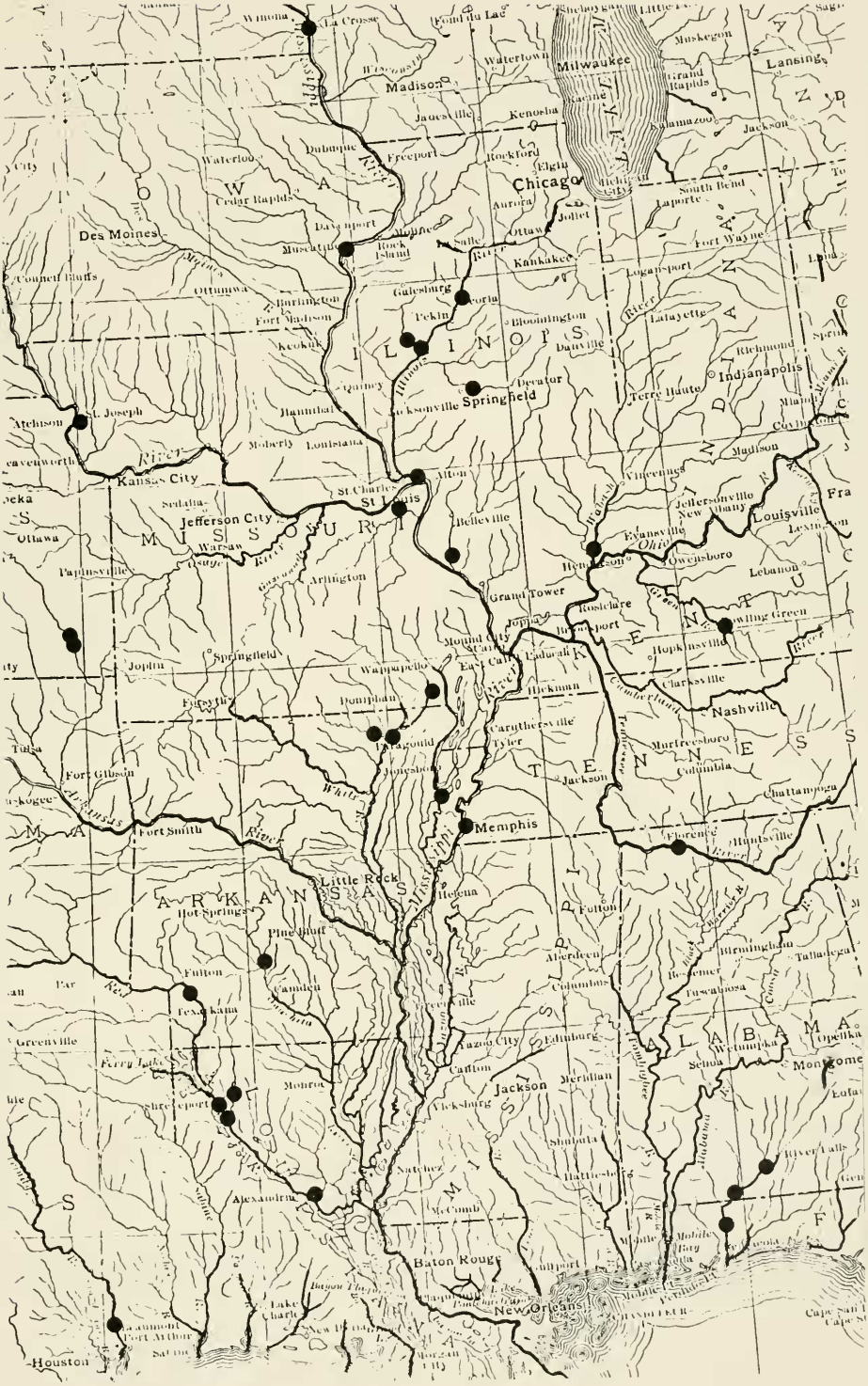

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Dubuque
Freeport
Rockford
Chicago
Elgin
Aurora
Joliet
Kenosha
Racine
Waterloo
Davenport
Muscatine
Rock Island
Galesburg
Peoria
Pekin
Bloomington
Lafayette
Kankakee
Fort Wayne
Indianapolis
Terre Haute
Springfield
Decatur
Jacksonville
Quincy
Hannibal
Fort Madison
Keokuk
Burlington
Ottumwa
Council Bluffs
St. Joseph
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Leavenworth
Kansas City
Moberly
Louisiana
St Charles
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Alton
Belleville
Jefferson City
Warsaw
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Arlington
Grand Tower
Cairo
Mound City
Thebes
Jonesboro
Cape Girardeau
Joplin
Springfield
Wappapello
Poplar Bluff
Doniphan
Pilot Knob
Carrollton
Tyler
Hickman
Paducah
Clarksville
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Murfreesboro
Columbia
Jackson
Fort Gibson
Tulsa
Fort Smith
Memphis
Florence
Huntsville
Little Rock
Hot Springs
Helena
Fulton
Pine Bluff
Camden
Fulton
Texarkana
Greenville
Ferry Lake
Shreveport
Monroe
Vicksburg
Jackson
Meridian
Aberdeen
Columbus
Tuscaloosa
Birmingham
Talladega
Selma
Montgomery
Opelika
Natchez
Alexandria
Baton Rouge
New Orleans
Lake Charles
Houston
Beaumont
Port Arthur
Mobile
Pensacola
Louisville
Owensboro
Evansville
Henderson
Jeffersonville
New Albany
Lebanon
Bowling Green
Hopkinsville
Lexington
Fort Wayne
Logansport
Richmond
Vincennes
Madison
Terre Haute
Lafayette
Kankakee
Ottawa
Aurora
Joliet
Elgin
Rockford
Freeport
Dubuque
Waterloo
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TENNESSEE
MISSOURI
ARKANSAS
MISSISSIPPI
ALABAMA
IOWA
Mississippi River
Missouri River
Ohio River
Illinois River
Tennessee River
Cumberland River
Arkansas River
White River
Red River
Wabash River
Kaskaskia River
Big Muddy River
Gasconade River
Osage River
Des Moines River
Iowa River
Cedar River
Wisconsin River
Rock River
Fox River
Kankakee River
Maumee River
Scioto River
Miami River
Whitewater River
Kentucky River
Green River
Licking River
Big Sandy River
Guyandotte River
Kanawha River
Monongahela River
Allegheny River
Youghiogheny River
Beaver River
Muskingum River
Hocking River
Scioto River
Miami River
Whitewater River
Kentucky River
Green River
Licking River
Big Sandy River
Guyandotte River
Kanawha River
Monongahela River
Allegheny River
Youghiogheny River
Beaver River
Muskingum River
Hocking River
Lake Michigan
Lake Erie
Lake Ontario
Lake Huron
Lake Superior
Lake Michigan
Lake Erie
Lake Ontario
Lake Huron
Lake Superior

Plate 6.

The distribution of *Cyprogenia aberti* (Conrad) (squares) and *Cyprogenia stegaria* (Rafinesque) (dots).

Cyprogenia aberti (Conrad) is found only in the Ozarkian Region. Below the Ozark Crest it is widely distributed; above the Crest, it is restricted to the Meramec River system.

Cyprogenia stegaria (Rafinesque). This species has persisted in the Cumberlandian Region, and may have had additional refugia in the Green, Allegheny and Monongahela river drainages.

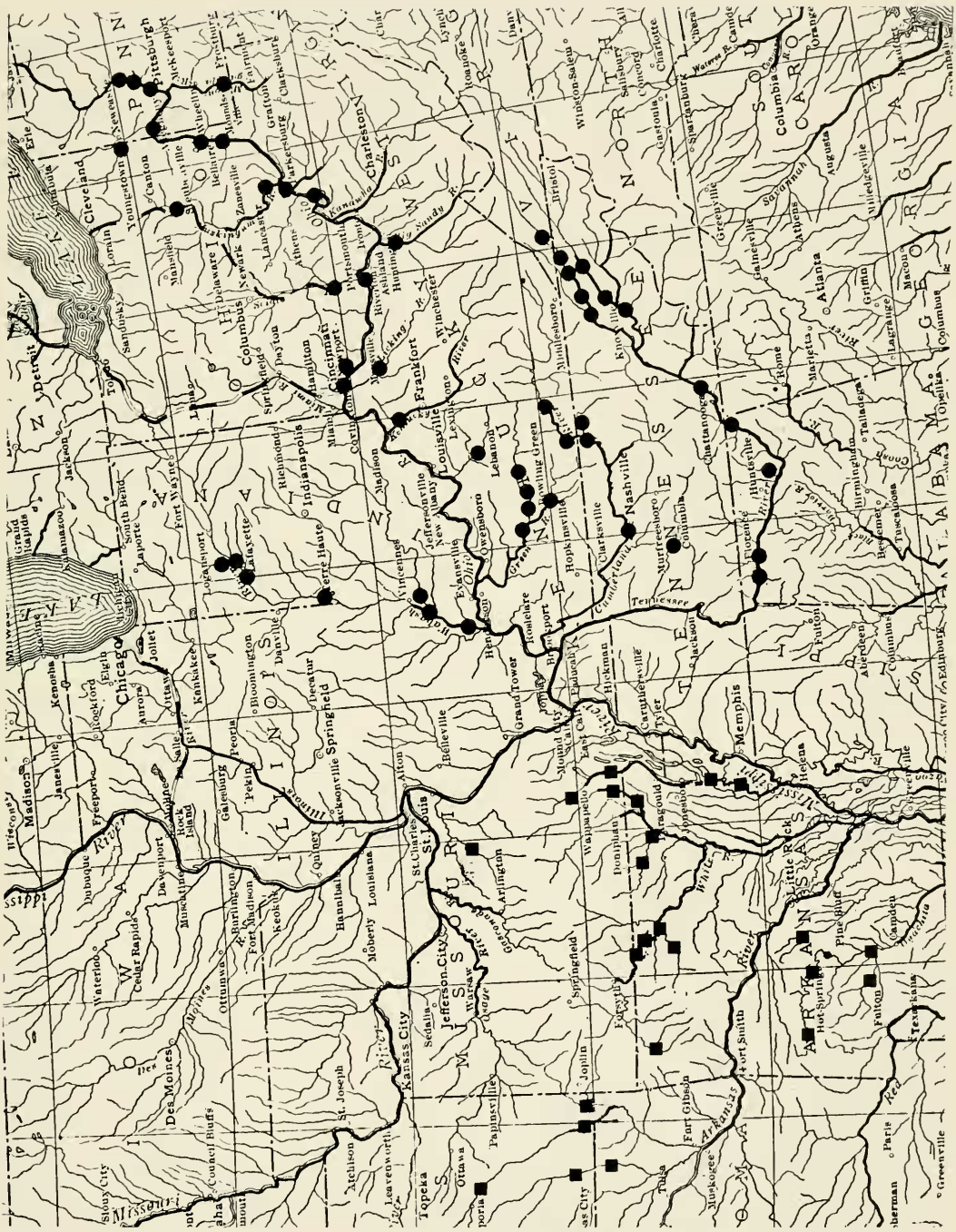

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Dayton
Hamilton
Madison
Lafayette
Terre Haute
Evansville
Owensboro
Hopkinsville
Clarksville
Murfreesboro
Chattanooga
Huntsville
Birmingham
Tuscaloosa
Montgomery
Columbus
Macon
Augusta
Savannah
Charlotte
Greensboro
Winston-Salem
Knoxville
Bristol
Roanoke
Lynchburg
Richmond
Norfolk
Wilmington
Columbia
Greenville
Spartanburg
Asheville
Gainesville
Athens
Rome
Marietta
Griffin
Milledgeville
Jackson
Vicksburg
Natchez
Baton Rouge
New Orleans
Mobile
Pensacola
Tallahassee
Jacksonville
Fernandina
Tampa
Orlando
Miami
Key West
Havana
Nassau
Bahama Islands
Cuba
Gulf of Mexico
Florida
Georgia
Alabama
Mississippi
Louisiana
Tennessee
Kentucky
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Indiana
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Iowa
Missouri
Arkansas
Kansas
Nebraska
Minnesota
Dakota
Montana
Wyoming
Colorado
Utah
Nevada
Idaho
Oregon
Washington
California
Arizona
New Mexico
Texas
Oklahoma
Indian Territory
Mississippi River
Missouri River
Ohio River
Tennessee River
Cumberland River
Arkansas River
Red River
Rio Grande
Colorado River
Columbia River
Snake River
Yellowstone River
Platte River
Kansas River
Illinois River
Wabash River
Kanawha River
Monongahela River
Allegheny River
Susquehanna River
Potomac River
James River
Delaware River
Hudson River
Connecticut River
Lake Superior
Lake Michigan
Lake Huron
Lake Erie
Lake Ontario
Lake Champlain
Lake Winnipeg
Lake Manitoba
Lake Athabasca
Great Slave Lake
Great Bear Lake
Great Salt Lake
Lake Tahoe
Lake Pontchartrain
Lake Okeechobee
Lake Maracaibo
Gulf Stream
Atlantic Ocean
Pacific Ocean
Arctic Ocean
Hudson Bay
Baffin Bay
Davis Strait
Greenland
Iceland
Labrador
Newfoundland
Nova Scotia
New Brunswick
Prince Edward Island
Quebec
Ontario
Manitoba
Saskatchewan
Alberta
British Columbia
Yukon
Mackenzie
Alaska
Aleutian Islands
Bering Sea
Bering Strait
Kamchatka
Japan
China
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Hawaiian Islands
Midway Islands
Samoa
Fiji Islands
New Zealand
Australia
Tasmania
New Guinea
Java
Sumatra
Borneo
Celebes
India
Ceylon
Arabia
Persia
Afghanistan
Turkestan
Siberia
Russia
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Cape of Good Hope
Madagascar
Abyssinia
Sudan
Algeria
Tunis
Morocco
Tripoli
Sahara
Canary Islands
Azores
Cape Verde Islands
Bermuda
Jamaica
Haiti
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Porto Rico
Trinidad
Barbados
Windward Islands
Leeward Islands
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Natchitoches
Lake Charles
Beaumont
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Orange
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Sabine River
Neches River
Trinity River
Brazos River
Colorado River
Guadalupe River
Nueces River
Rio Grande
Pecos River
Canadian River
Arkansas River
Red River
Ouachita River
Black River
St. Francis River
White River
Yazoo River
Pearl River
Tombigbee River
Alabama River
Chattahoochee River
Flint River
Apalachicola River
Suwannee River
St. Johns River
Kissimmee River
Everglades
Big Cypress Swamp
Okefenokee Swamp
Dismal Swamp
Great Dismal Swamp
Chesapeake Bay
Delaware Bay
Long Island Sound
Cape Cod
Martha's Vineyard
Nantucket
Block Island
Narragansett Bay
Boston Harbor
Portland
Bangor
Augusta
Concord
Manchester
Nashua
Lowell
Lawrence
Haverhill
Salem
Gloucester
Fall River
New Bedford
Providence
Hartford
New Haven
Bridgeport
Stamford
Norwalk
Yonkers
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Newark
Paterson
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Trenton
Camden
Atlantic City
Cape May
Wilmington
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Lancaster
Harrisburg
York
Gettysburg
Chambersburg
Hagerstown
Frederick
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Annapolis
Washington
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Petersburg
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Bristol
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Chattanooga
Cleveland
Dalton
Rome
Gadsden
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Talladega
Selma
Montgomery
Tuskegee
Auburn
Opelika
Columbus
Macon
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Brunswick
Jacksonville
Fernandina
St. Augustine
Daytona
Orlando
Tampa
St. Petersburg
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Fort Myers
Key West
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West Palm Beach
Fort Pierce
Jacksonville
Gainesville
Ocala
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Columbia
Shelbyville
Murfreesboro
Nashville
Clarksville
Hopkinsville
Paducah
Cairo
Mound City
Metropolis
Carbondale
Cape Girardeau
Sikeston
New Madrid
Caruthersville
Blytheville
Helena
West Memphis
Forrest City
Jonesboro
Paragould
Pocahontas
Walnut Ridge
Batesville
Searcy
Conway
Russellville
Fort Smith
Van Buren
Siloam Springs
Fayetteville
Rogers
Bentonville
Eureka Springs
Harrison
Mountain Home
Hot Springs
Arkadelphia
Prescott
Texarkana
Magnolia
El Dorado
Camden
Pine Bluff
Stuttgart
Dumas
Helena
Marianna
Jacksonville
Pine Bluff
Little Rock
North Little Rock
Conway
Searcy
Batesville
Jonesboro
Blytheville
Osceola
Wilson
Memphis
Somerville
Bolivar
Jackson
Humboldt
Trenton
Dyersburg
Union City
Martin
Paris
Huntingdon
Lexington
Jackson
Bolivar
Corinth
Iuka
Florence
Sheffield
Tuscumbia
Huntsville
Decatur
Athens
Pulaski
Columbia
Shelbyville
Murfreesboro
Nashville
Clarksville
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Metropolis
Carbondale
Cape Girardeau
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Pocahontas
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Batesville
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Russellville
Fort Smith
Van Buren
Siloam Springs
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Rogers
Bentonville
Eureka Springs
Harrison
Mountain Home
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Arkadelphia
Prescott
Texarkana
Magnolia
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Pine Bluff
Stuttgart
Dumas
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Marianna
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Little Rock
North Little Rock
Conway
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Jonesboro
Blytheville
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Wilson
Memphis
Somerville
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Trenton
Dyersburg
Union City
Martin
Paris
Huntingdon
Lexington
Jackson
Bolivar

Plate 7.

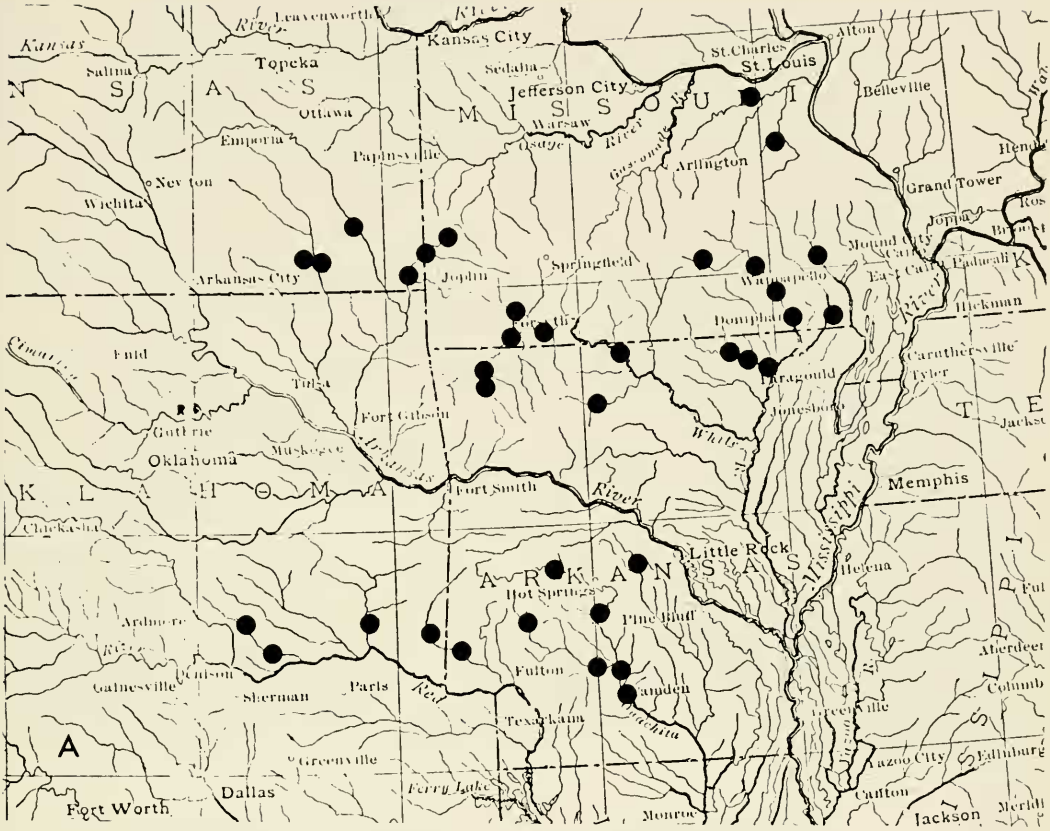
A. The distribution of *Ptychobranchus occidentalis* (Conrad).

Found only in the Ozarkian Region, below the Ozark Crest from the Red to the St. Francis river systems; above the Crest, it is restricted to the Meramec River system.

Ptychobranchus fasciolare (Rafinesque) (Table 2 C, Table 3 A), a closely related species, that has persisted in the Cumberlandian Region, and may have had additional refugia in the Green, Allegheny and Monongahela river drainages, has a distribution in the Ohioan region, which is very similar to *Cyprogenia stegaria* (Rafinesque) (Plate 6, dots). In addition, it spread into Lake Erie (Plate 1 D).

B. The distribution of *Villosa reeviana* (Lea).

Found only in the Ozarkian Region, below the Ozark Crest in the White River system; above the Crest, it occurs in the Osage, Gasconade, and Meramec river systems.


Kansas
Leavenworth
Kansas City
Topeka
Salina
Ottawa
Emporia
Jefferson City
Sedalia
Warsaw
Osage
Gasconade
Arlington
St. Charles
St. Louis
Alton
Belleville
Grand Tower
Mound City
Cairo
Paducah
Hickman
Carutherseville
Tyler
Paragould
Jonesboro
Wichita
Newton
Arkansas City
Joplin
Springfield
Wapanucka
Enid
Tulsa
Fort Gibson
Guthrie
Oklahoma
Muskogee
Arkansas
Fort Smith
White
Memphis
Mississippi
Little Rock
Hot Springs
Pine Bluff
Helena
Arthur
Denison
Gainesville
Sherman
Paris
Red
Fulton
Camden
Texarkana
Greenville
Fort Worth
Dallas
Ferry Lake
Monroe
Vicksburg
Jackson
A

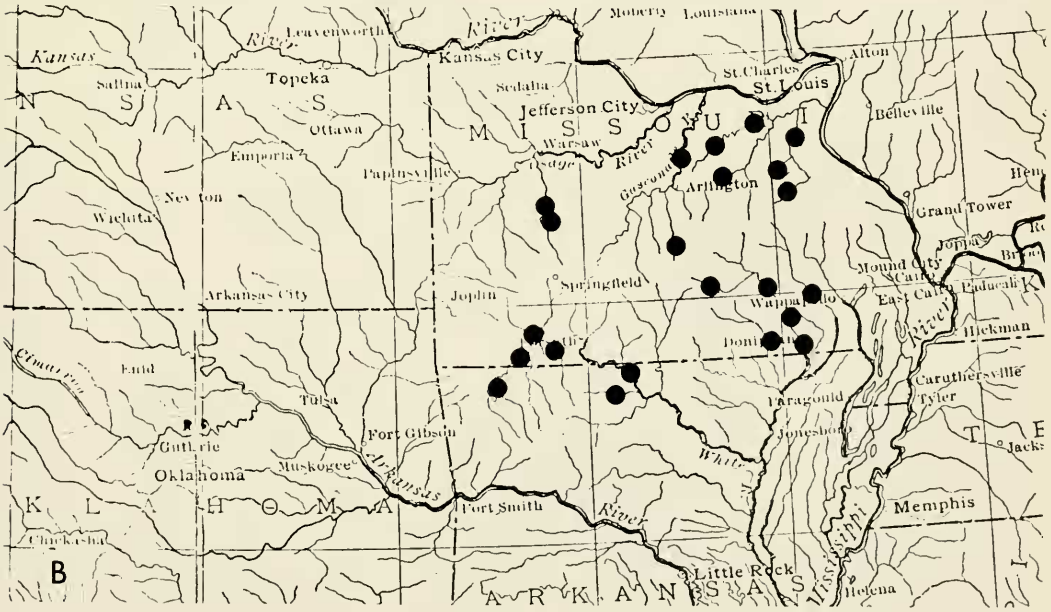

Moberly
Louisiana
Kansas
Leavenworth
Kansas City
Topeka
Salina
Ottawa
Emporia
Jefferson City
Sedalia
Warsaw
Osage
Gasconade
Arlington
St. Charles
St. Louis
Alton
Belleville
Grand Tower
Mound City
Cairo
Paducah
Hickman
Carutherseville
Tyler
Paragould
Jonesboro
Wichita
Newton
Arkansas City
Joplin
Springfield
Enid
Tulsa
Fort Gibson
Guthrie
Oklahoma
Muskogee
Arkansas
Fort Smith
White
Memphis
Mississippi
Little Rock
Helena
B

Plate 8.

A. The distribution of *Fusconaia ozarkensis* (Call) (dots), *Arkansia wheeleri* Ortmann and Walker (triangles), and *Villosa arkansasensis* (Lea) (squares).

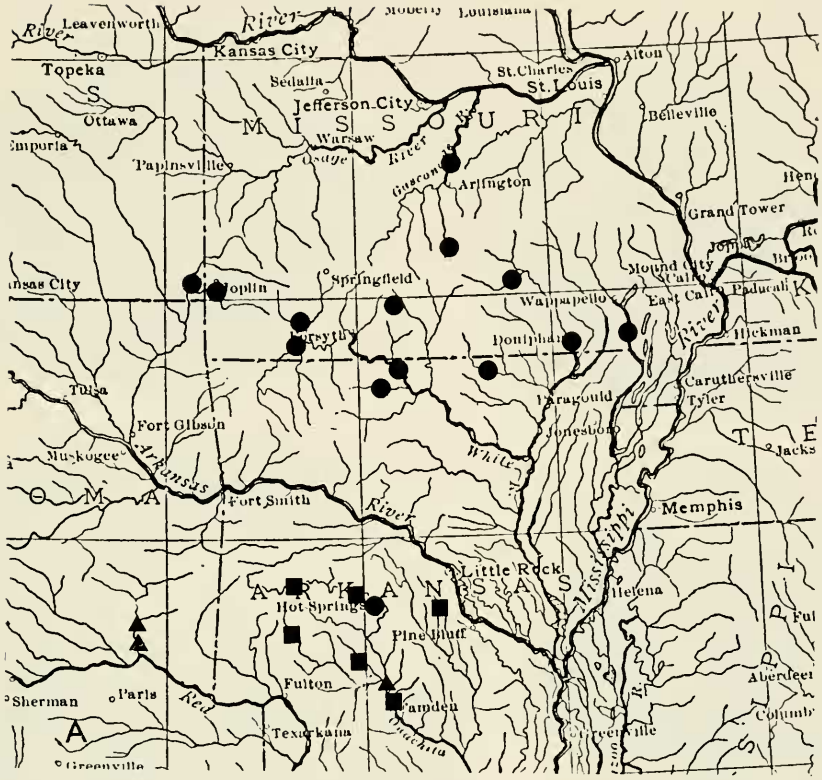
Fusconaia ozarkensis (Call) is found only in the Ozarkian Region, below the Ozark Crest, in the Ouachita River drainage of the Black River system, the Neosho River drainage of the Arkansas River system, the White and St. Francis river systems; above the Crest it is restricted to the Gasconade River system.

Arkansia wheeleri Ortmann and Walker is found only in the Ozarkian Region, below the Ozark Crest, in the upper Red and Black river systems.

Villosa arkansasensis (Lea) is found only in the Ozarkian Region, below the Ozark Crest, in the upper Black River system.

B. The distribution of *Actinonaias rafinesqueana* (Frierson) (dots), and *Lampsilis powelli* (Lea) (triangles).

Actinonaias rafinesqueana (Frierson) is found only in the Ozarkian Region below the Ozark Crest, in the upper Red and White river systems. The location of the Black River record is conjecture. This species is close to the Cumberlandian species, *Actinonaias pectorosa* (Conrad). *Lampsilis powelli* (Lea) is found only in the Ozarkian Region, below the Ozark Crest, in the Saline River drainage of the Black River system; the upper Arkansas, and upper White river systems. The location of the White River record is conjecture. This species is close to the Cumberlandian species, *Lampsilis virescens* (Lea).


Leavenworth
Kansas City
Topeka
Ottawa
Emporia
Sedalia
Jefferson City
Warsaw
Osage River
Gasconade River
Arlington
Papinsville
Joplin
Springfield
Alton
St. Charles
St. Louis
Belleville
Grand Tower
Mound City
Cairo
Wappapello
East Cairo
Paducah
Hickman
Carutthersville
Tyler
Jonesboro
Tulsa
Fort Gibson
Muskogee
Arkansas River
Fort Smith
White River
Memphis
Little Rock
Hot Springs
Pine Bluff
Helena
Fulton
Sherman
Paris
Red River
Texarkana
Camden
Ouachita River
Greenville
Aberdeen
Columbus
Jackson

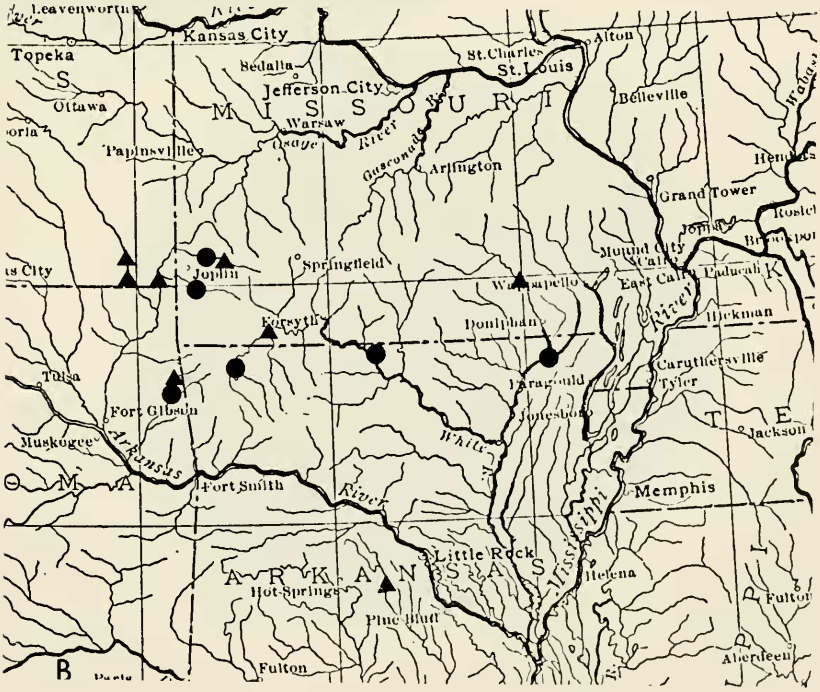

Leavenworth
Kansas City
Topeka
Ottawa
Sedalia
Jefferson City
Warsaw
Osage River
Gasconade River
Arlington
Papinsville
Joplin
Springfield
Alton
St. Charles
St. Louis
Belleville
Grand Tower
Mound City
Cairo
Wappapello
East Cairo
Paducah
Hickman
Carutthersville
Tyler
Jonesboro
Tulsa
Fort Gibson
Muskogee
Arkansas River
Fort Smith
White River
Memphis
Little Rock
Hot Springs
Pine Bluff
Helena
Fulton
Jackson

Plate 9.

Fusconaia ozarkensis (Call)

Figure 1. *Unio ozarkensis* Call. Big Creek, [of Current River], Texas Co., Missouri. Paralectotype MCZ 5710. Length 55, height 37, width 19 mm.

Figure 2. *Pleurobema brevis subelliptica* Simpson. Spring River, Hardy, Fulton Co., Arkansas. Paralectotype USNM 159952a. Length 43, height 28, width 16 mm.

Figure 3. *Pleurobema utterbackii* Frierson. White River, Hollister, Taney Co., Missouri. Holotype MCZ 271448, right valve. Length 68, height 42, width 26 mm.

Figure 4. *Quadrula flava sampsoniana* Frierson. Elk River, McDonald Co., Missouri. Holotype MZUM 92226. Length 54, height 37, width 19 mm.

Anodonta (*Utterbackia*) *suborbiculata* Say

Figure 5. Mercer Bayou, N Black Diamond, Miller Co., Arkansas. MCZ 293508. Length 71, height 58, width 26 mm.

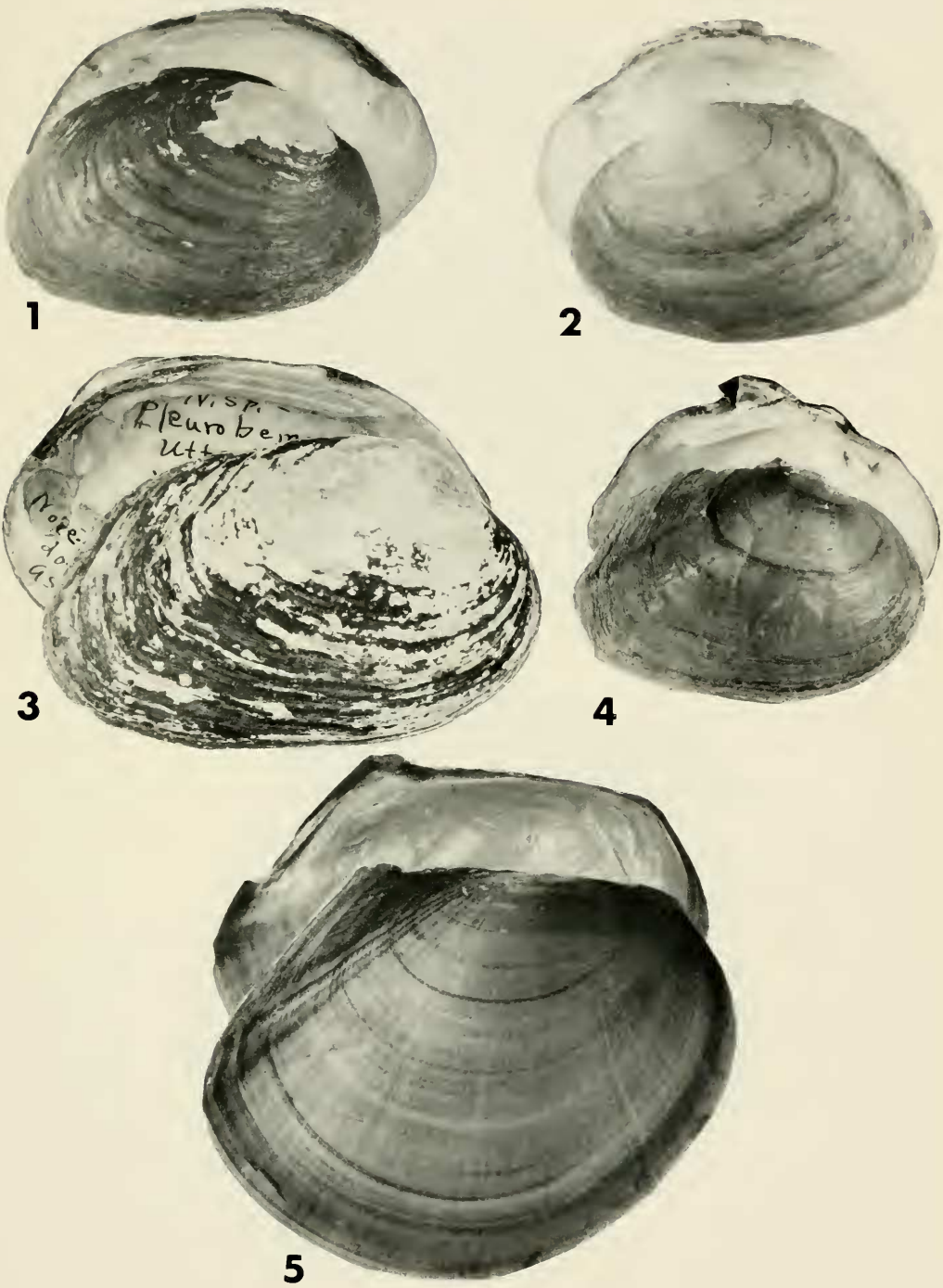
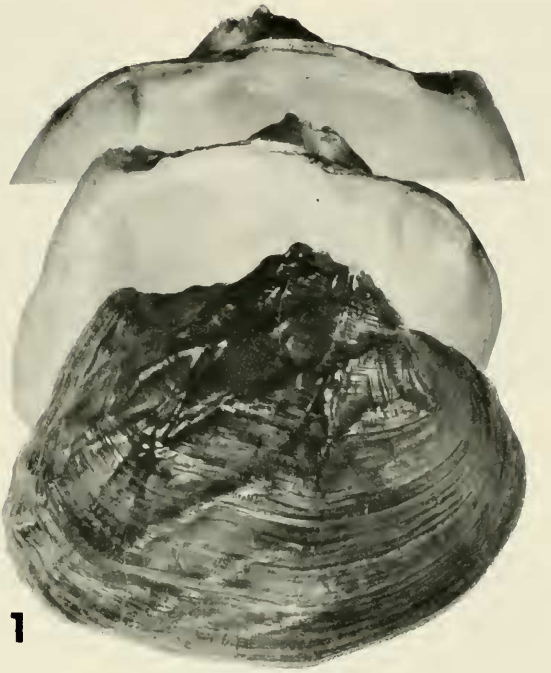

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Plate 10.

Arcidens confragosus (Say)

Figure 1. *Alasmidonta confragosa* Say. Fox River of the [Little] Wabash [River, Richland Co., Illinois]. Topotype MCZ 53004. Length 88, height 68, width 45 mm.

Figure 2. *Arcidens confragosa jacintoensis* Strecker. San Jacinto River, Liberty Co., Texas. Topotype MCZ 23317. Length 82, height 57, width 32 mm.



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Plate 11.

Arkansia wheeleri Ortmann and Walker

Figure 1. *Arkansia wheeleri* Ortmann and Walker. Old River [a bayou of the Ouachita River], Arkadelphia, Clark Co., Arkansas. Holotype MZUM 105514. Length 73.5, height 62, width 41 mm.

Actinonaias rafinesqueana (Frierson)

Figure 2. *Lampsilis rafinesqueana* Frierson. Illinois River, Moodys, Cherokee Co., Oklahoma. Holotype MZUM 87576. Length 86, height 60, width 35 mm. Female.

Figure 3. *Lampsilis rafinesqueana* Frierson. Illinois River, Moodys, Cherokee Co., Oklahoma. Paratype MZUM 90665. Length 69, height 43, width 26 mm. Female.

Figure 4. *Lampsilis rafinesqueana* Frierson. Illinois River, Moodys, Cherokee Co., Oklahoma. Paratype MZUM 90665. Length 62, height 37, width 21 mm. Male.

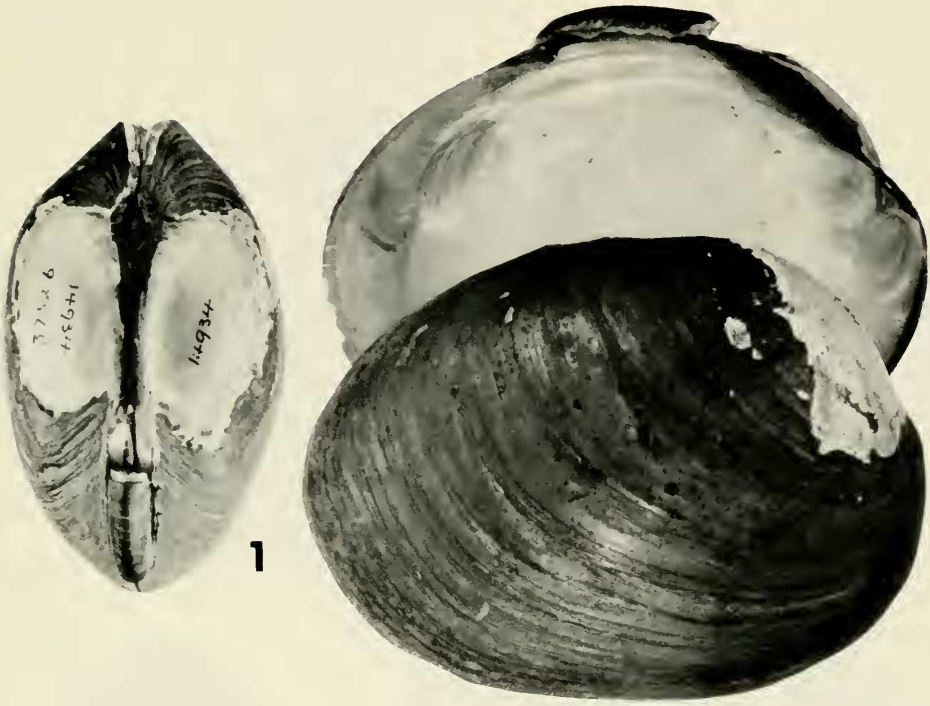

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Plate 12.

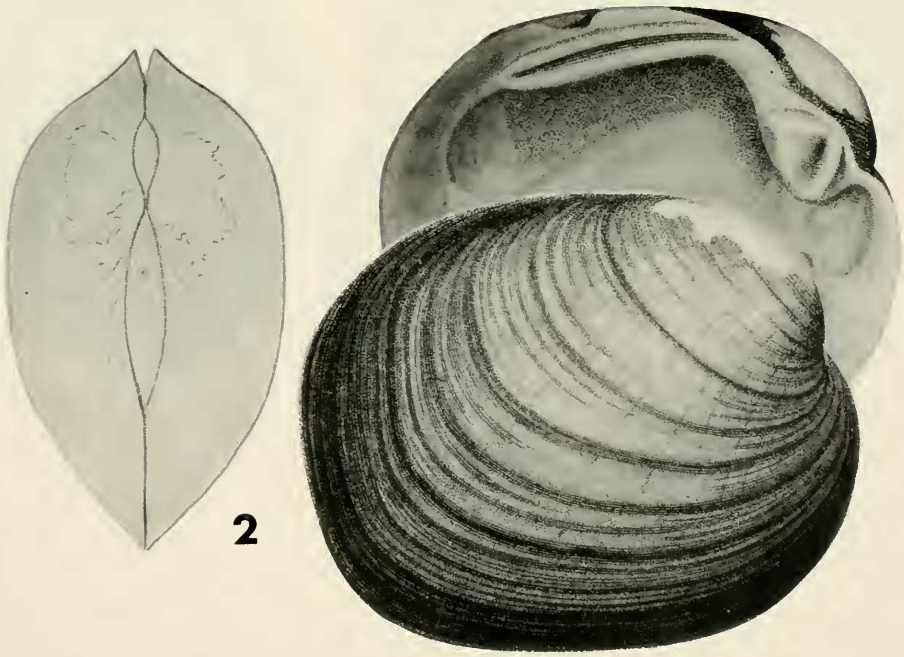
Lampsilis (*Lampsilis*) *abrupta* (Say)

Figure 1. Ohio River, Cincinnati, Hamilton Co., Ohio. MCZ 37526. Length 82, height 63, width 40 mm. Male.

Figure 2. *Unio abruptus* Say. Wabash [River, New Harmony, Posey Co., Indiana]. Figured holotype [lost] from Say. Length 71, height 60, width 40 mm [based on original figure]. Female.



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Plate 13.

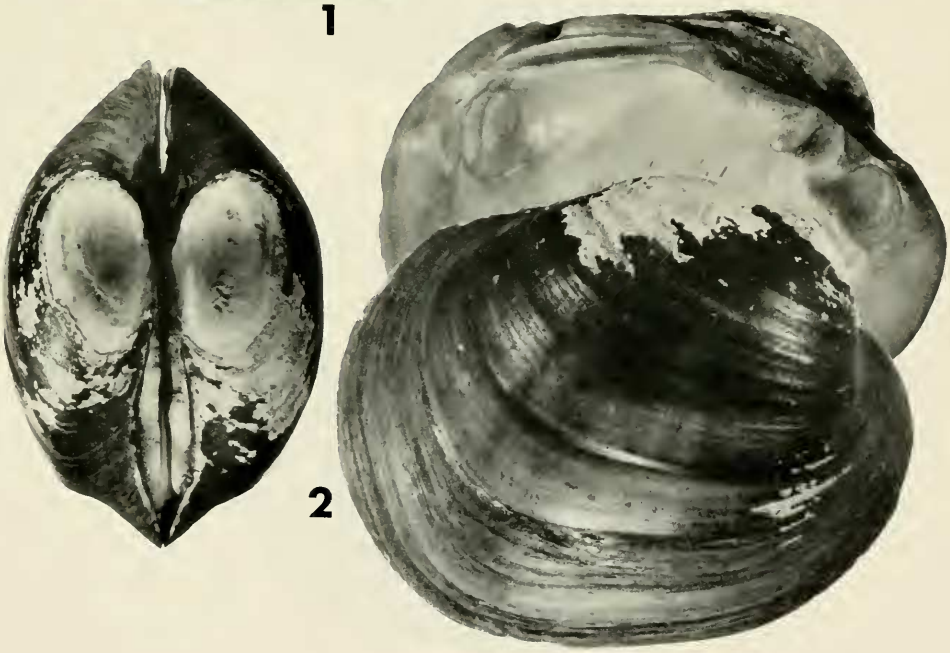
Lampsilis (*Lampsilis*) *higginsi* (Lea)

Figure 1. *Unio higginsii* Lea. [Mississippi River], Muscatine, [Muscatine Co.], Iowa. Holotype USNM 84823. Length 81, height 59, width 48 mm. Male.

Figure 2. Mississippi River, near Aledo, Mercer Co., Illinois. MCZ 288383. Length 81, height 61, width 51 mm. Female.



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Plate 14.

Lampsilis satur (Lea)

Figure 1. *Unio satur* Lea [Red River], Alexandria, [Rapides Parish], Louisiana. Holotype USNM 84505. Length 80, height 61, width 51 mm. Female.

Figure 2. Saline River, Benton, Saline Co., Arkansas. MZUM 33758. Length 74, height 55, width 35 mm. Male.

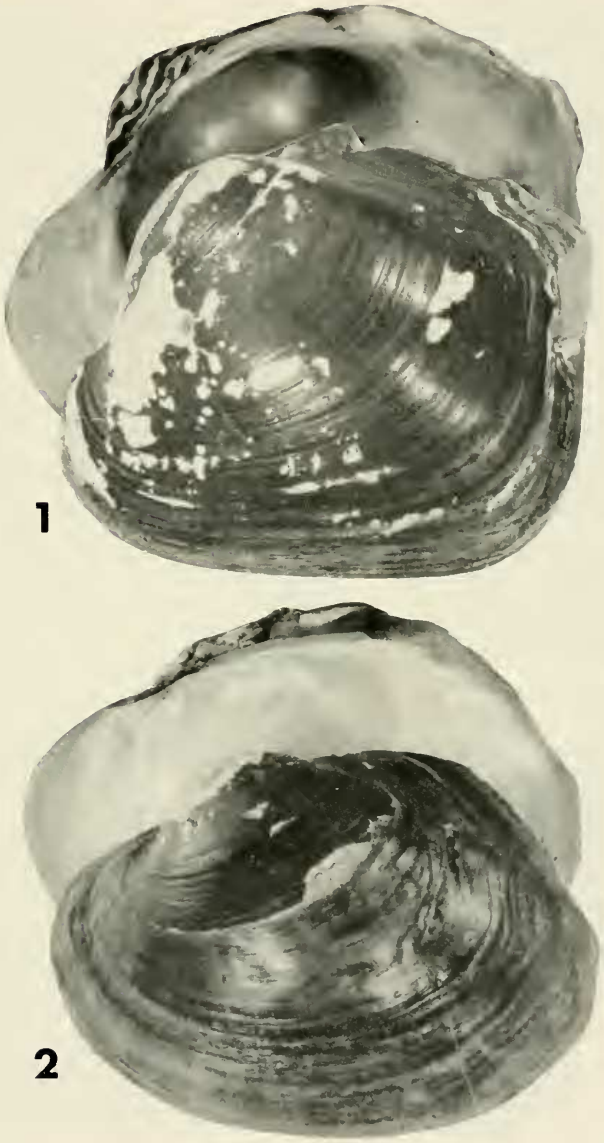

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Plate 15.

Lampsilis excavata (Lea)

Figure 1. Saline River, Benton, Saline Co., Arkansas. MCZ 293585. Length 72, height 50, width 33. Male.

Figure 2. Saline River, Benton, Saline Co., Arkansas. MCZ 293585. Length 78, height 54, width 38 mm. Female.

Lampsilis powelli (Lea)

Figure 3. *Unio powelli* Lea. Saline River, Arkansas. Holotype USNM 85024. Length 80, height 56, width 29 mm. Male.

Figure 4. *Unio powelli* Lea. Saline River, Arkansas. Allotype USNM 85024a. Length 77, height 39, width 24 mm. Female.

Lampsilis hydiana (Lea)

Figure 5. *Unio hydianus* Lea. Teche River, [St. Landry Parish], Louisiana. Holotype USNM 85010. Length 64, height 37, width 27 mm. Male.

Figure 6. *Unio hydianus* Lea. [Red River], Alexandria [Rapides Parish], Louisiana. Allotype USNM 85010a. Length 57, height 37, width 28 mm. Female.

Figure 7. *Unio placitus* Lea. 1852. Alabama. Holotype USNM 85152. Length 34, height 22, width 15 mm. Male.

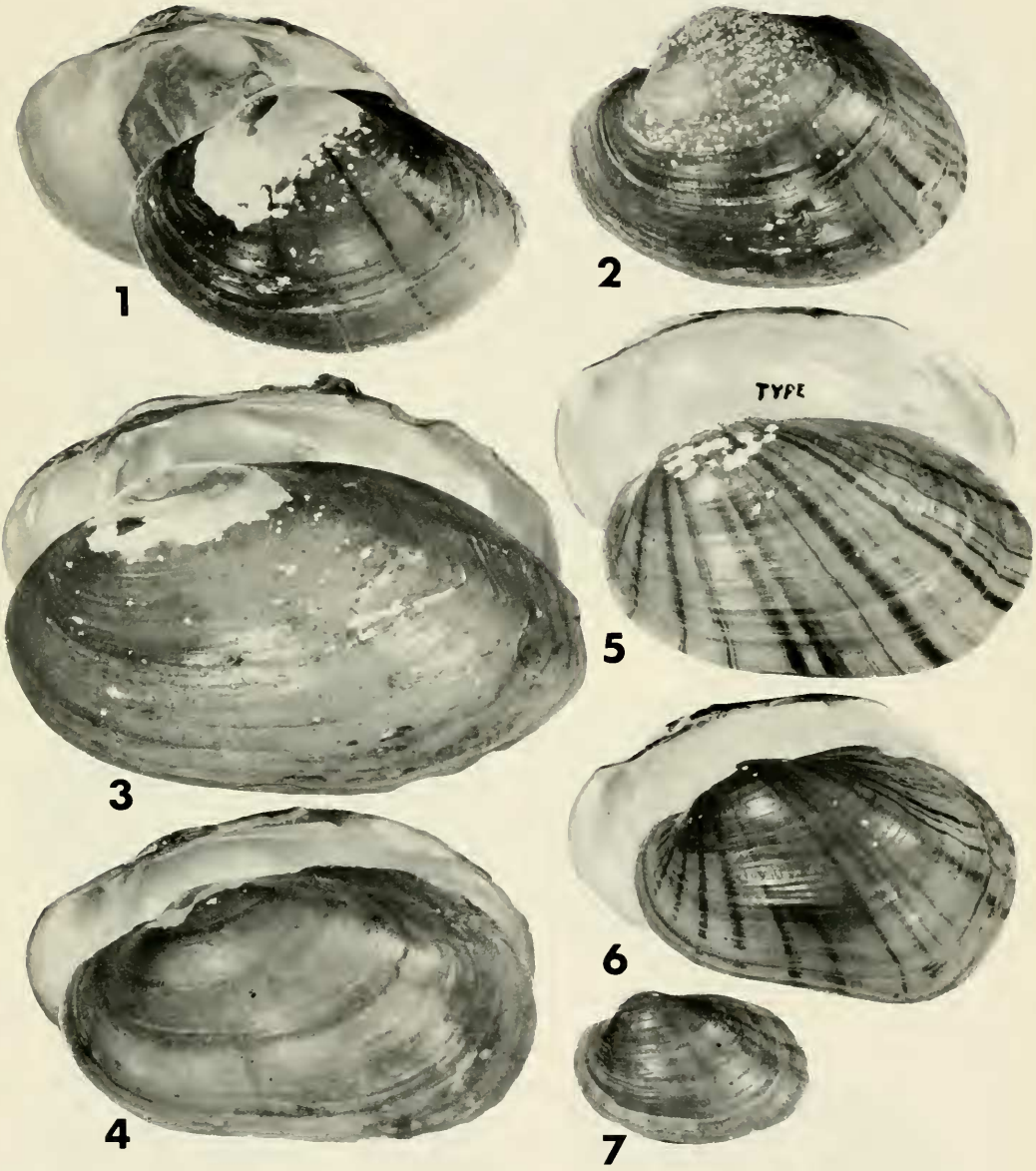

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Plate 16.

Proptera capax (Green)

Figure 1. Mississippi River, Muscatine, Muscatine Co., Iowa. MCZ 5043. Length 79, height 59, width 54 mm.

Figure 2. Niagara River, Buffalo, Erie Co., New York. Collected by Elizabeth Letson, 1906, with the note, "Only one I ever found." Buffalo Museum of Science (approx. nat. size).

Villosa arkansasensis (Lea)

Figure 3. *Unio arkansasensis* Lea. [Ouachita River] near Hot Springs, Garland Co., Arkansas. Holotype USNM 25710. Length 40, height 28, width 18 mm. Male.

Figure 4. Saline River, Benton, Saline Co., Arkansas. MCZ 4989. Length 37, height 27, width 18 mm. Female.

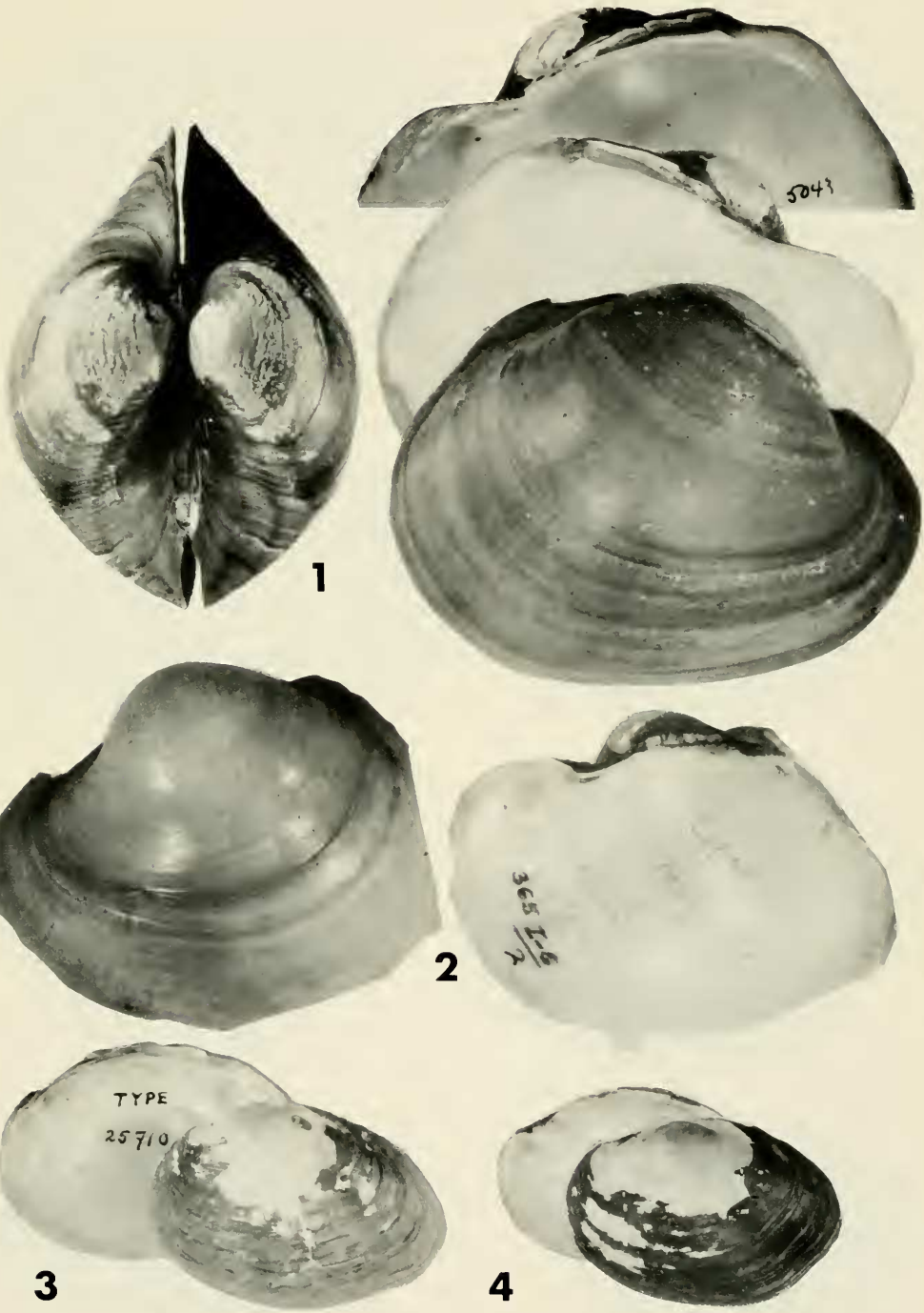

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Plate 17.

Villosa reeviana (Lea)

Figure 1. *Unio reevianus* Lea. [White River, Elkins, Washington Co., Arkansas]. Holotype USNM 85025. Length 75, height 41, width 28 mm. Male.

Figure 2. *Unio reevianus* Lea. White River, Arkansas. Allotype USNM 85025a. Length 62, height 40, width 24 mm. Female.

Figure 3. *Unio breviculus* Call. Jacks Fork [of Current River, Shannon Co.], Missouri. Lectotype MCZ 5020. Length 64, height 40, width 24 mm. Male.

Figure 4. *Unio breviculus* Call. Big Creek [of Current River, Texas Co.]Missouri. Allotype MCZ 5023. Length 58, height 40, width 25 mm. Female.

Figure 5. *Lampsilis brittsi* Simpson. [Little Niangua River, Camden Co., Missouri. Topotype MCZ 293574, from J. P. Britts. Length 47, height 30, width 18 mm. Female.

Villosa vibex (Conrad)

Figure 6. *Lampsilis streckeri* Frierson. Little Red River, Arkansas. Holotype MZUM 91075. Length 65, height 38, width 22 mm. Male.

Figure 7. Onion Creek [Colorado River system], Travis Co., Texas. MZUM 79921. Length 49, height 31, width 16 mm. Male.

Figure 8. Onion Creek [Colorado River System], Travis Co., Texas. MZUM 79921. Length 53, height 32, width 19 mm. Female.

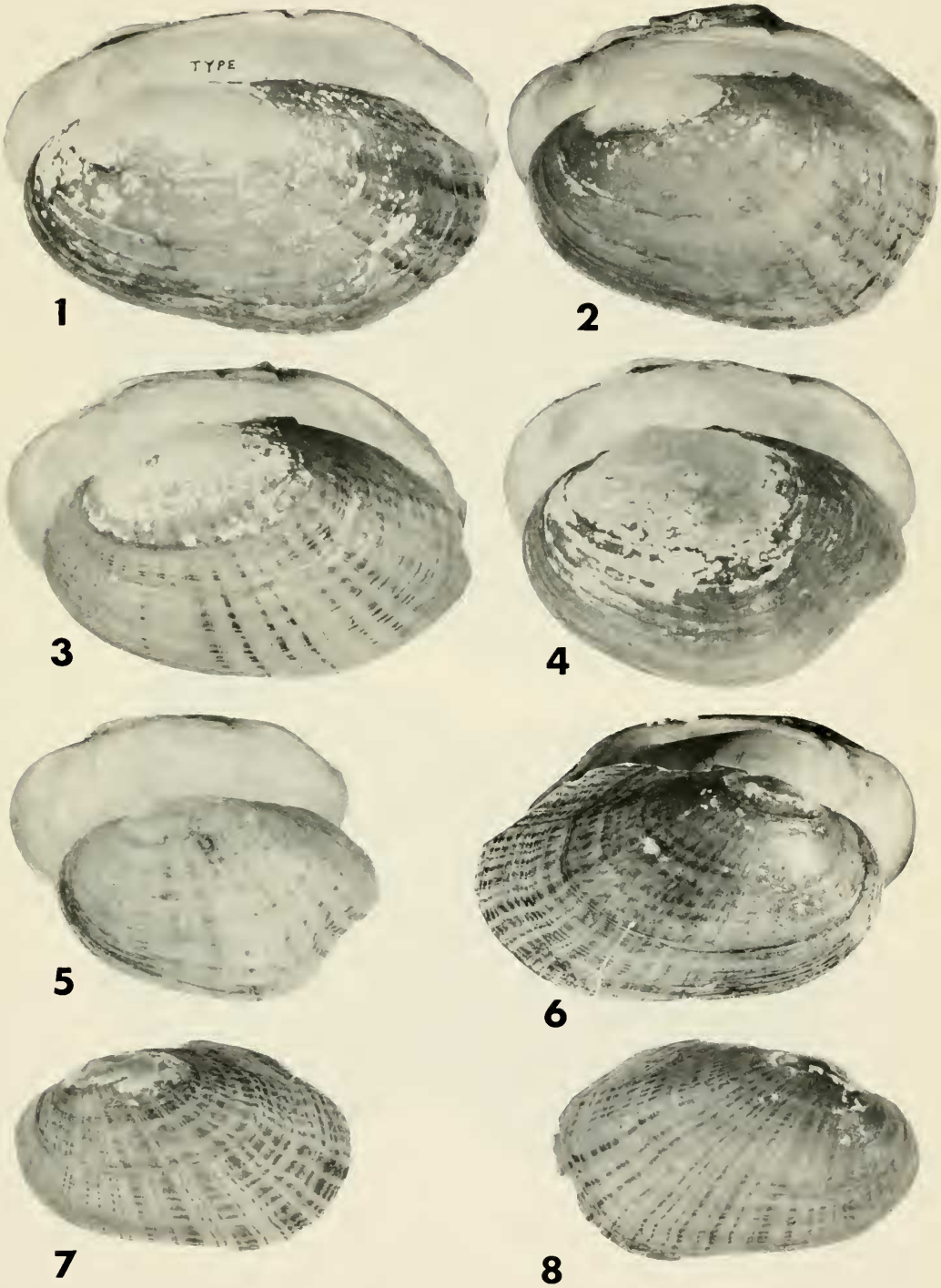

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Plate 18.

Cyprogenia stegaria (Rafinesque)

Figure 1. *Obovaria stegaria* Rafinesque. Ohio River. Lectotype ANSP 20215. Length 47, height 49, width 32 mm.

Figure 2. *Unio irroratus* Lea. Ohio River, Cincinnati, Hamilton Co., Ohio; T. G. Lea. Paratype USNM 84299; the figured holotype is missing. Length 51, height 54, width 35 mm.

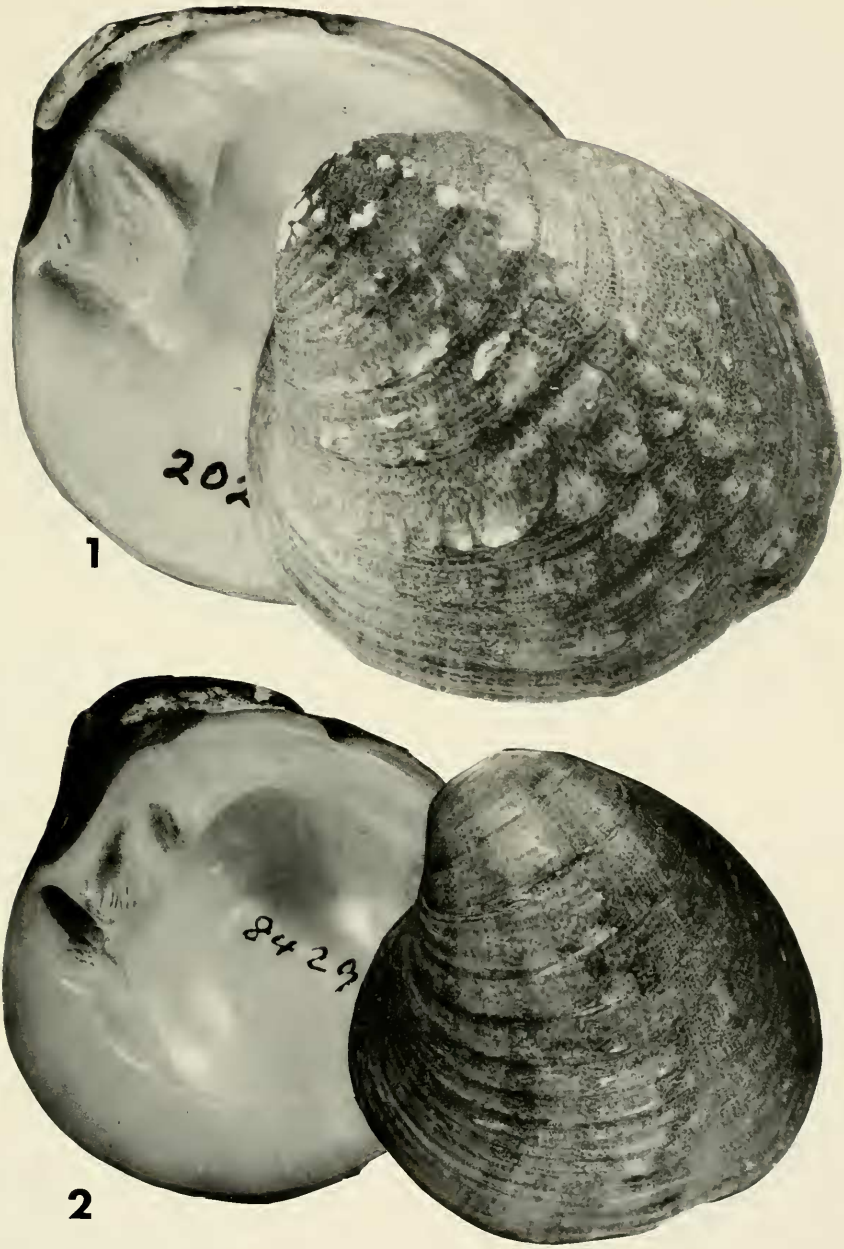

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Plate 19.

Cyprogenia stegaria (Rafinesque)

Figure 1. *Cyprogenia irrorata pusilla* Simpson. Green River, Mammoth Cave, Edmonson Co., Kentucky. Lectotype USNM 152004. Length 43, height 37, width 29 mm.

Figure 2. Tuscarawas River, New Philadelphia, Tuscarawas Co., Ohio. MCZ 14409. Length 50, height 45, width 27 mm.

Cyprogenia aberti (Conrad)

Figure 3. Saint Francis River, Wittsburg, Cross Co., Arkansas. MCZ 5492. Length 48, height 46, width 29 mm.

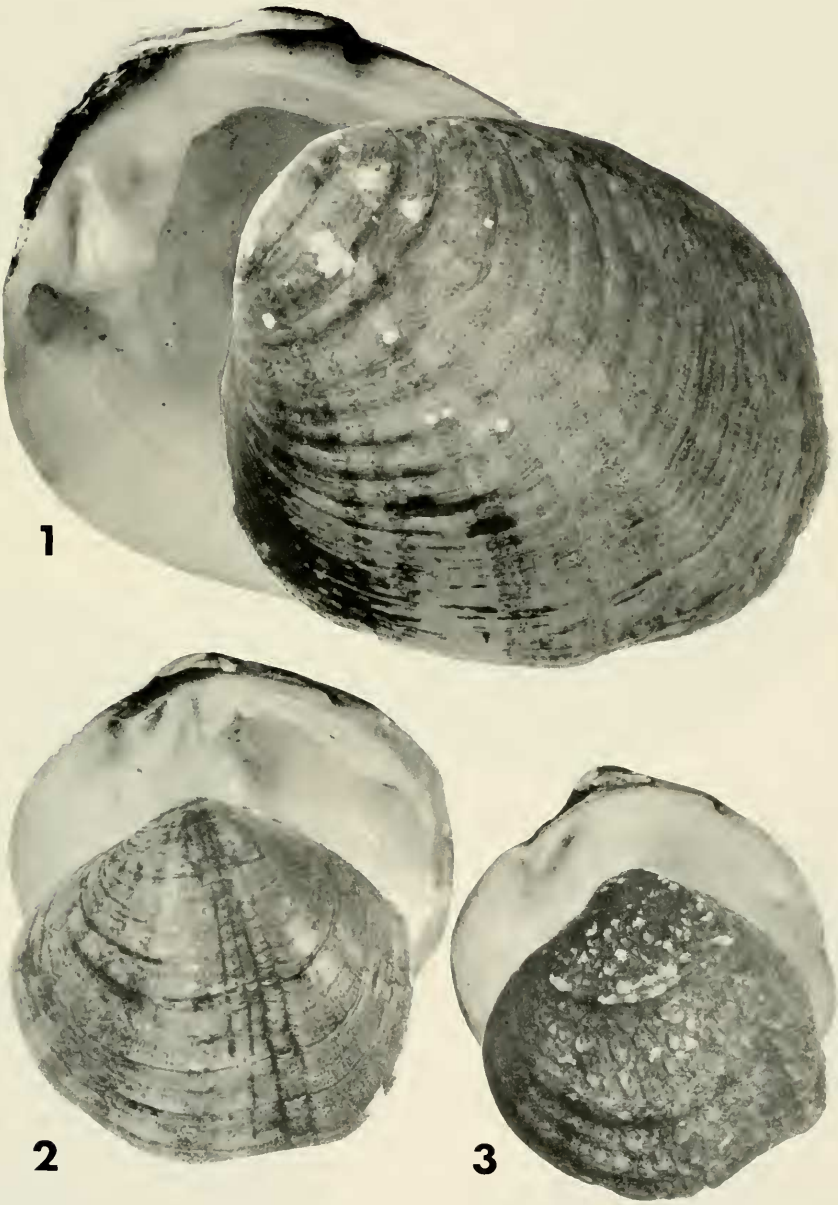

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Plate 20.

Cyprogenia aberti (Conrad)

Figure 1. *Unio aberti* Conrad. Rapids of Verdigris River, Chambers Ford [not located; Oklahoma]. Figured holotype [lost] after Conrad. Length 40, height 34, width 15 mm.

Figure 2. *Unio lamarckianus* Lea. White River, Arkansas. Holotype USNM 84306. Length 37, height 30.5, width 13 mm.

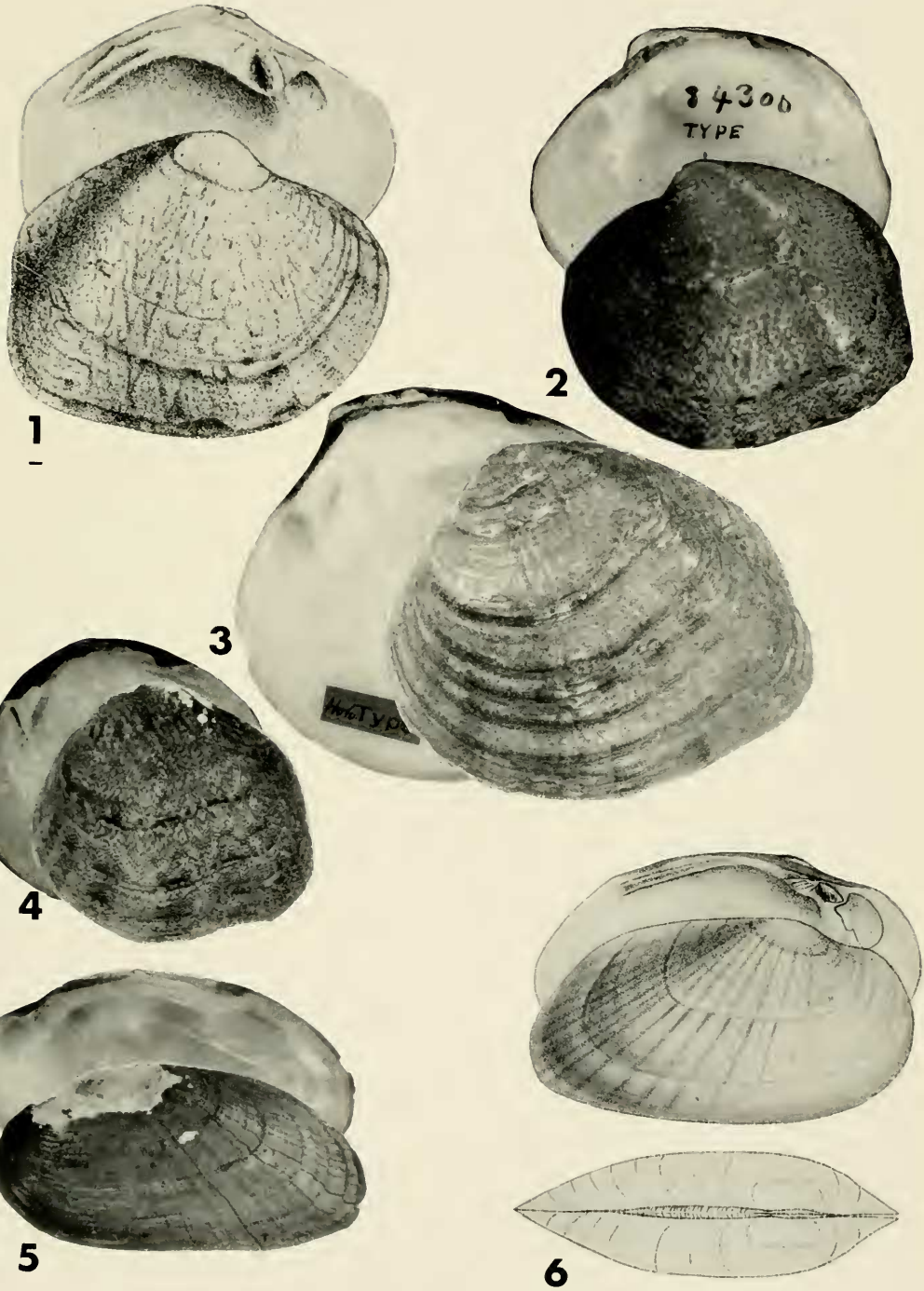
Figure 3. *Unio popenoi* Call. Fall River, Wilson Co., Kansas. Holotype MCZ 4943. Length 78, height 68, width 39 mm.

Figure 4. Meramec River, [near Franklin Co. line]. Crawford Co., Missouri. Specimen loaned by R. D. Oesch. Length 39, height 37, width 24 mm.

Ptychobranchus occidentalis (Conrad)

Figure 5. *Ptychobranchus clintonensis* Simpson. Archies Fork of Little Red River, near Clinton, Van Buren Co., Arkansas. Paratype MCZ 192371. Length 57, height 29, width 16 mm.

Figure 6. *Unio occidentalis* Conrad. Currant [Current] River, [Randolph Co.], Arkansas. Figured holotype [lost] from Conrad. Length 52, height 28, width 17 mm [based on original figure].


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